DOCTOR OF PHILOSOPHY

An investigation into user interaction and user experience with games for the elderly on motion-based and touch-based games focusing on older people between the age of 55 to 75

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An Investigation into User Interaction and User Experience with Games for the Elderly on Motion-based and Touch-based Games Focusing on Older People between the Age of 55 to 75

By

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A Serious Game Framework for Older People

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

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Dedicated to my husband and family.

Thank you for believing in me.

To my late father, Haji Jali Haji Kenoi

Papa, this is for you!

ABSTRACT

Digital game technology has been adopted by many sectors and in almost every discipline, which includes education, military, business, health care, psychology and computer science. This is due to the engaging factor of gameplay offered by digital games. In recent years, the application of games is becoming a popular medium in promoting healthy lifestyle and improving the quality of life especially for older people; for instance fostering social connectedness motivated and stimulated through social interaction, cognitive exercises and physical activity that can be afforded by digital game technology. It is essential that users or players are captivated and engaged by the game before any serious purposes/activities can be imposed. This study aims to investigate the correlation between the challenges associated with older people, their existing engagement with digital gaming and the andragogical perspectives. An empirical investigation into user interactions and experiences with a focus on the older people and their engagement towards digital games on console and mobile platforms. Thus, this will lead towards a validated insights into game design personalised to the needs and expectations of the target population. Two studies (*Preliminary Study* and *Further Investigation Study*) were performed with 114 participants aged 55 to 75. 14 participants participated in *Preliminary Study* and 100 participants in *Further Investigation Study*. Data was collected from their interactions with and experiences of digital gaming. Questionnaires and group discussions were utilised in order to collect their feedback, perceptions and perspectives on the experience. The study's results show a guideline and game considerations that can be used by the designers, developers and researchers when considering the interaction and experience of older people for digital game design.

Keywords: older people, ageing population, andragogy, user interaction, user experience, digital games, game with purpose

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Thank you very much.

DECLARATION

I declare that the work in this dissertation was carried out in accordance with regulation of the Coventry University. The work is original, except where indicated by special reference in the text, and no part of the dissertation has been submitted for any other academic award. Any views expressed in the dissertation are those of the author.

Suriati Khartini binti Jali

March 2017

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GLOSSARY OF ABBREVIATIONS

Acronym	Meaning
SG	Serious Game
PC	Personal Computer
VBS2	Virtual Battlespace 2
VBS3	Virtual Battlespace 3
B3	Billstedt-Bürger-Beteiligung
EC	European Commission
WHO	World Health Organization
UN	United Nations
ONS	Office for National Statistics
COTS	Commercial off-the-shelf
GBL	Game-based learning
UX	User Experience
ISO	International Organisation for Standardisation
ARC	Age Research Centre
ESA	Entertainment Software Association
TEC	Technology Enabled Care
NHS	National Health Service
HCP	Healthcare Professional
ICT	Information and Communications Technology
MDA	Mechanics, Dynamics, Aesthetics
RETAIN	Relevance, Embedding, Transfer, Adaption, Immersion and Naturalisation
4DF	Four-dimensional Framework
ADGL	Adaptive Digital Game-based Learning
PR:EPARe	Positive Relationships: Eliminating Coercion and Pressure in Adolescent Relationships
MMORPG	Massively Multiplayer Online Role-Playing Games
RSVP	Research Volunteer Support Programme
OPA	Older People in Action
HDTI	Health Design and Technology Institute
SMS	Short message service
TOG	The Older Gamers
DMLL	Disruptive Media Learning Lab
QUIS	Questionnaire for User Interaction Satisfaction
BOS	Bristol Online Surveys

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CHAPTER 1

INTRODUCTION

1.1 Background

The size of the ageing population is increasing rapidly. Based on the census conducted by the Office for National Statistics (ONS), it is reported that there would be 24% more people aged 65 and over; and 39% more people aged 85 and over in England in 2021 compared to 2011 (Parliament. House of Lords, 2013). The ONS also projected that in England, a 51% rise in those aged 65 and over; and a 101% growth in people aged 85 and over from 2010 to 2030. In 30 years, one in five people in the world will be over 60 years of age or older (Akitunde, 2012) and is predicted that this population segment will reach two billion by 2050 (Aalbers *et al.* 2011, WHO 2002).

According to Kaufman (2013), older people at the age of 60 were likely to encounter declining physical and cognitive abilities on top of a change of lifestyle, bereavement of loved one, lack of social support and a high tendency to having a chronic and severe illness. Kaufman also stated that the deficits brought an impact on a large number of respondents, especially towards their lifestyles.

Physical and cognitive declines were the main factors of ageing. Declining social capacities are directly proportional with declines in physical, cognitive and emotional functions (WHO 2002, Kaufman 2014) and these could lead to other implications, such as illness, dependence and low quality of life. Refer **Section 2.6** for more details with regard to the challenges faced by the older people.

In relation to lifestyle related to ageing, Sixsmith *et al.* (2007) indicated that technology has a great potential in supporting the well-being of older people by improving their physical, mental, and social challenges. Furthermore, technology is seen to provide stimulating, meaningful and enjoyable activities and environment. Aligning with the same perspective, recent developments show that technology-based games are also being used and well-accepted towards catering the needs of various target groups, including the older people. Furthermore, the game-based approach is also perceived to offer many benefits to the older population especially in improving their social life and to add joyfulness in their daily routine

(Keyani 2005, Khoo *et al*. 2006), as well as to improve their quality of life (Chen *et al.* 2012). This could be in the form of motivating and stimulating way through social interaction, cognitive exercise, and physical activity (Astell 2013).

However, even with the expanded use of games (apart from leisure and entertainment) in military, industry, health care, education and business, very little work has been carried out towards supporting the needs and preferences of older people (Ijsselsteijn *et al.* 2007, Mubin and Al Mahmud 2008, De Schutter and Abeele 2008, Awad *et al.* 2014). This is due to the main target group is mostly aimed at younger people, where it is deemed to be more commercially viable. Previous research reported that digital games have been used solely for leisure and commonly associated to a much younger demography, mainly children, teenagers and younger adults (Ijsselsteijn *et al.* 2007, Mubin and Al Mahmud 2008, De Schutter and Abeele 2008). The main reason was that it is more profitable to sell digital games to teenagers and younger adults (ESA 2013).

Therefore, in this thesis, this issue was addressed by proposing an empirical investigation into user interaction and experiences with a focus on the older people and their engagement with digital games specifically on console and mobile -based. Thus, understanding the user is a very crucial aspect. This will lead towards validated insights into game design personalised to the needs and expectations of the target population, older people.

1.1.1 Motivation

For the past decades, digital games have become a popular recreational activity. It has gained popularity among the younger generation namely for children, adolescents and young adults. However, with the evolving and availability of new technologies, such as game consoles, which aimed for casual gamers, different target users have also been considered (i.e. older people). Older people could potentially become the large consumer of the digital gaming market (computer and online games). Refer **Section 2.2** for Older People definition.

In 1996, Adler (1996) reported that 60% of computer owners also played computer games are over 55. According to Lenhart *et al.* (2008), 40% of Americans aged 50 to 65 play video games. A study of 1,200 households by the Entertainment Software Association (ESA) reports that 26% of video game players are men and women over the age of 50. Also, the same study shows that more than a quarter of the gaming population is over 50 (ESA, 2009).

In 2011, 29% of Americans over the age of 50 play video games, an increase from 9% in 1999 (ESA, 2011). This figure shows that percentage of older people playing digital games via console or computer device is increasing year-by-year. According to Ijsselsteijn *et al.* (2007), the numbers of older people who play digital game vary and determined by the age groups and the geographical location (country). For example, in the UK, 18% (approximately 1.7 million) of the 51 to 65 years old population play digital games while 52% older people aged 65 and over play digital games in Finland (Pratchett, 2005). This is particularly interesting as the marketing and design of digital games were often focused on young people in mind rather than older people. In fact, many older people are interested in playing games and this is a promising area for developers and researchers to explore and invest more. On top of this, existing research reveals that age directly links with the amount of money spent on virtual goods within social games. The older the gamer, the more they spend (Gaudiosi, 2011). This is due to the older demographics have more disposable income than younger demographics.

Recently, research shows that digital games in the near future will focus on older people (Guardian, 2015). As the population ages, the number of older gamers will also increase. People who were the first to grow up with video games will grow older and continue to play. Also, some might just discover gaming in their later years and indulge in the gaming activities.

It has been recently addressed that game can bring positive impact to older people especially to generate cognitive, physical and mental wellbeing (Astell, 2013). As mentioned earlier, declined in social abilities are linked with declines in physical, cognitive and emotional functions (WHO, 2002; Kaufman, 2014). Thus, an effective cognitive training may slow down cognitive decline, which could result in improving the quality of life and independence for older people (Whitlock, 2014).

Another motivation that triggers to study this research is to understand the importance of user interaction and experience towards games by older people. Due to natural age-related changes within the older people (i.e. decline in cognitive and physical abilities), researchers and designers must be aware of these challenges and consider the varied gaming needs and interests of this ageing population.

Several studies indicate that age-related factor changes the influence on playing games among older people. Thus, Ijsselsteijn *et al.* (2007), Flores *et al.* (2008), Gerling *et al.* (2012)

and Romero *et al.* (2010) proposed the game design requirements for older people as the outcome of their studies. Refer next section.

Furthermore, the andragogical perspectives were also included to understand how older people perceive and use the technology (in this case is the digital game). The findings from this study may offer additional game design considerations on top of the existing one.

1.1.2 Related works

As early as the 1980s, research on usages of video games targeting older people has been conducted. The studies by Weisman (1983) shows that the video games had been introduced to institutionalised (residential institution for) older people. Based on his study, Weisman asserted that a game should have different levels of difficulties to support individual preferences and sensorimotor abilities. In addressing visual and auditory impairment, the authors suggested using large fonts, well-defined visual symbols and clear auditory feedback as part of the design requirement (Weisman, 1983).

Apart from Weisman (1983), there are several other studies which addressed game design requirements that are compatible with the older people's cognitive, motor and perceptual abilities. Whitcomb (1990) and Ijsselsteijn *et al.* (2007) proposed several game designs and recommended appropriate user interface for older people, which emphasises on impairments in visual and auditory perception and a loss of sensorimotor skill. The approach was extended by Flores *et al.* (2008), where the authors recommended the design of appropriate cognitive challenges, where it should also include a simple user interface and the ability to provide feedback. Another set of design approach was proposed by (Gamberini *et al.*, 2006), where the authors train and evaluate the cognitive as well as social ability of the older people via a tabletop gaming solution, called the *ElderGames*.

There were a number of game designs specifically focusing on older people; which mainly focusing on accessibility (Gerling and Masuch, 2011) and player performance (Gerling *et al.*, 2010). Due to challenges faced and lack of technological experience, the older generation is observed to have the usability problems compared to the younger generation.

On the game design and the apparatus for rehabilitation gaming for older people, studies showed that older people have specific gaming needs and preferences (Awad *et al.* 2014). It is also observed that their abilities are different compared to the younger people (Pearce,

2008; Nap *et al.*, 2009; Nacke *et al.*, 2009; ESA, 2011). In the studies by De Schutter and Abeele (2008), the authors proposed to design a game that meets the older peoples' needs and interests; it should consider topics that are related to older peoples' lives and experiences, foster connectedness and nurture one's self and others. Gerling *et al.* (2012) echoed De Schutter and Abeele (2008) by suggesting the aspect of user experience and sufficient information needs to be examined and provided, to capture the adequate interaction between players and the games. Studies by Romero *et al.* (2010) however indicated that involvement by older people themselves throughout the design process is important to obtain valuable information in meeting their needs (the transactions of the ageing process that relate to their likes and dislikes).

These studies indirectly point out the importance of andragogical perspectives when it comes to designing and developing games, specifically for older people. *Andragogy* can be defined as the art and science of '*helping'* adults learning. This is based on the assumption of the two different learner groups; adults and children (Knowles, 1984). It shows that the way adults learn or perceive a certain thing is different from children. Therefore, to promote learning for an adult will require a different approach, through adopting the andragogical perspectives. Further discussion on andragogy is discussed in **Section 2.7**. This study will highlight and look at how is learning (andragogical perspectives) relevant to the design considerations. Thus, the older people interactions and experiences towards new technologies can be considered as a learning process by looking at on 'how they can be encouraged to interact' and 'how their interactions can be investigated'.

Previous studies have shown the benefits and challenges of game design for older people. However, such studies did not consider the correlation between the attributes of game technology and other critical elements such as andragogical perspectives and challenges associated with the targeted group. Thus, as been mentioned above, this study will highlight the correlation between the challenges associated with older people, their existing engagement with digital gaming and the andragogical perspectives. This study also introduced and utilised several commercial off-the-shelf (COTS) digital games to the targeted group. Older people interactions (*social interaction, interaction with the device, interaction through the game*) and experiences (needs, interests and preferences) while playing digital games are observed and collected during the study process to obtain the game design considerations.

As indicated in the findings reported in the literature review, it showed that the possibilities of game utilisation could bring positive impacts to the older people. A purposely-built game could attract people to get engaged and continue to play. However, it is essential that older people be captivated and engaged by the game before any serious purposes can be imposed.

For older people, it is important to envisage technology as a tool that is beneficial and offers positive impact, which could lead to assured acceptance (Ijsselsteijn, 2007, Romero, 2010). Thus, the older people's interactions (*social interaction, interaction with the device, interaction through the game*) and experiences (needs, interests and preferences) should be taken into account by considering the andragogical perspectives and challenges faced when designing a game for them.

In this thesis, a guideline into design considerations towards a purposely-built game for older people is proposed based on the investigations on their interactions and experiences towards digital games. It is believed that through this guideline, older people could be attracted to be engaged and continue to play the designed game. To investigate the user interaction and experience, a study on the types of games and their associated attributes (user, contexts, representation and theory) are conducted at the early stage. Refer **Chapter 3** to look at the design frameworks that were considered in guiding the investigations. The ease of data collection process (i.e. what, why, how), analysis and interpretation were also being considered in this research.

1.2 Problem Statements

The study focuses on the older people as the target user group. This is due to several reasons. Firstly, most methodologies or frameworks for designing and developing games were particularly developed for the general type of games (commercial games) and aiming for younger users in mind. Secondly, there are small numbers of research with the intention of designing and developing games for older people. However, none of these researches are correlating the attributes of game technology and the consideration such as andragogical perspectives and challenges faced by the targeted group. Therefore, this thesis proposed such guideline and design considerations to overcome the issues addressed earlier in this thesis.

1.3 Research Aim and Objectives

The main aim of this research is **to investigate user interaction and experience with digital games on console and mobile platforms focusing on older people between the age of 55 to 75**. There are three objectives of this research:

i. **Investigation** into:
   - the challenges associated with older people,
   - andragogical perspectives,
   - their engagement with digital gaming (interaction and experience), and
   - game design attributes.

ii. **Analysis** of the game design attributes (users, contexts, representation and theory) based on the target group's interaction and experience with digital games, and

iii. **Discussion** of the game design considerations for targeting older people.

1.4 Research Questions

This study sets out to seek answers to the following research questions. The following questions are posed to understand further the key considerations that related to the game design requirements for older people:

Research Question 1 (RQ1):

i. How do older people interact with digital game technology, and how can their game experience inform design considerations?

Research Questions 2 (RQ2):

ii. How the interaction with the digital game technology informs older peoples' perceptions of the technology?

Research Question 3 (RQ3):

iii. What other aspects that would influence older people's perspectives towards digital games?

1.5 Significance of the Study

Technology has become a necessity in today's world. These days, technology is not only meant to benefit the younger generation. The use of technology has also expanded to include the needs of the older generation as well. With regards to the older people, research indicates that technology provides stimulating, meaningful and enjoyable activities and the environment. It is considered as a supporting element for enhancing older people's well-being, through improving their physical, mental, and social challenges. Technology-based games are seen to offer many benefits to the older population especially in improving their social life, by motivating and stimulating way through social interaction, cognitive exercise, and physical activity (Astell, 2013).

With the existence of the game (whether it is a game for single player or multiplayer), older people can spend their time playing games amongst themselves (at home, care centres) or with their family members. Thus, not only that the games become enjoyable, but it will also have the ability to strengthen the relationship among players, and also to encourage social interaction among them or to the society around them (De Schutter and Malliet, 2014).

The investigation into user interactions and experiences on any games focusing on this target user can be seen as a stepping stone to provide guidelines for designing such games. To achieve this, androgogical perspectives and challenges faced by the older people are taken into consideration to meet their needs and preferences.

1.6 Thesis Overview

The thesis is outlined in seven chapters. The introduction chapter, Chapter 1, provides the necessary background to the research, research problem statements, the research purpose and its aim and objectives. The literature review for this study is divided into two chapters, Chapter 2 and Chapter 3. Chapter 2 reviews the literature on the definition of serious games and older people and provides general statistics of older people. Also, the reasons for choosing older people as the intended target group is discussed. Furthermore, the challenge of getting older is presented, and justification for the target sample age range is attempted. Apart from that, the discussion on andragogy versus pedagogy, andragogy and the technology and their technology acceptance are also presented. In Chapter 3, the discussion is based on the

existing game design frameworks and attributes. Besides that, design considerations based on four quadrants (*User*, *Context*, *Representation* and *Theory*) are also discussed.

Chapter 4 discusses the research methodology, which provides justification for the chosen research approach as well as data collection and analysis methods and procedures together with ethics consideration. The results and analysis of findings from Phase 1 - Focus groups conducted with different groups from several chosen forums and groups from Coventry and Warwickshire are reported in Chapter 5. Meanwhile, Chapter 6 analyses the data collected from Phase 2 (through survey dissemination and a series of focus groups) in order to further investigate and validate the findings from Phase 1. To conclude this thesis, Chapter 7 highlights the analysis and discussion of the overall research findings. Limitations of the study will also be discussed and recommendations provided for possible future studies.

CHAPTER 2

OLDER PEOPLE, TECHNOLOGY AND DIGITAL GAMES

Chapter 2 presents findings, which have emerged from the reviewing of literatures that are relevant to this research. This chapter consists of eight (8) main sections: Section 2.1 presents the general introduction of the research followed by the definition, statistics and demographics of older people, leading to a discussion on the motivation behind the focus on older people as the intended target group in Section 2.2. Later in Section 2.3, the terms of Interaction and Experience are explained. Literature reviews on older people and their acceptance towards technology are described in Section 2.4. While in Section 2.5, the importance of digital games and older people is discussed. Section 2.6 discusses the challenges associated with ageing. The explanation of the andragogy and pedagogical models followed by a discussion on andragogy and technology can be found in Section 2.7 and Section 2.8, respectively. Lastly, Section 2.9 summarises the chapter and findings.

2.1 Introduction

A comprehensive review of the literature on serious games and older people with no date restrictions were placed on the searches and all relevant areas included, as long as it is written in English. This was done to evaluate and present a comparative analysis on the state-of-the-art of the game design considerations for older people, particularly in investigating their interaction and experience with games. The key search terms involve the keywords: *older people and serious games, elderly, senior, game-based learning, technology acceptance among senior, older people and technology*. Several electronic databases were used as search tools including IEEE Xplore, Scopus, ACM, Elsevier, HubMed, PubMed, PsycINFO and SpringerLink. Meanwhile, Google and Google Scholar, leading search engines currently available were used as two main search engines for searching relevant information in the targeted field.

To date, educational games have become increasingly popular, used by teachers in school to facilitate learning activities among students (Knight *et al*. 2010, Rebolledo-Mendez *et al*. 2009, Arnab *et al*. 2013). In Korea, an 'edutainment' is not a new phenomenon. The online game has been extensively used and applied in the education sector (Lee and Han 2007). The

Consolarium, a game-based-learning (GBL) initiative of Education Scotland shows how the appropriate use of games in the classroom can bring positive impacts on teaching and learning (Education Scotland 2013). While in Quebec, Canada, game (*World of Classcraft*) has been used to teach physics in an exciting way and has successfully motivated and engaged the students to learn (Ward 2013). A similar situation happened in Denmark, where Boas (2013) found that the Danish school children learned English language from playing computer games, which they found more intriguing, interesting and a fun way of learning. This has shifted the perception towards computer games from being totally entertainment (Baranowski *et al.* 2008) or 'recreational activity' to something more meaningful and useful to life. The birth of game such as *Dakim BrainFitness* and *Dr Kawashima's Brain Training* has opened the eyes of our modern society towards accepting computer games as a positive element in daily life.

Based on Bourgonjon *et al.* (2013), games will be used if it can inspire or has a direct link to the curriculum. Teachers also play an important role in adopting game based learning (GBL) approach in their teaching and learning. Hainey *et al.* (2011) stated that with sufficient support, a game for teaching and learning is shown to be motivational and helps in learning high level or complex skills.

2.2 Older People

There are various definitions of older people. In general, it is relative. For example, a teenager may perceive people who are over 25s as 'older people'. Meanwhile, a person in their 30s may identify a person over 60s as 'older people'; a newly-retired person may think the 80-year-old people fall into the category. Therefore, it is important to identify and define this target group correctly.

Researchers define older people as:

> *"... people in the United Kingdom are administratively regarded as old around their 60-65th birthdays, largely because of retirement and pension policies"* (Garrett 1990).

> *"Retirement age is the most common boundary (by life stage, social transition or physiological - incapacity, menopause, greying hair, wrinkles) in countries with pension systems"* (Wilson 2000).

In the United Kingdom (UK), the retirement age for a man is 65 and 60 for a woman. However, both of the European Commission (EC) and the United States of America (USA) uses 60 years old as the cut-off age. Contrary to all this, Walker and Maltby (1997) states that the changing nature of old age in European population in the late 20th century shows that *age structure, health and patterns of employment* play important roles in changing and transforming the meaning of old age.

According to Walker and Maltby (1997), early retirement, partial retirement, redundancy, unemployment, and disability were among different ways how people all over the European Union (EU) are leaving the labour force. Apart from that, authors reported that older people lived longer and healthier due to life expectancy increased. As a results, it helps in delaying their frailty.

Although many countries – especially the developed countries, linked the definition with retirement age (60 or 65), however, retirement no longer becomes the indicator of old age. Hence, it is increasingly anachronistic as a definition of older people (Walker and Maltby 1997).

According to World Health Organization (WHO), 65 years is the chronological age accepted in most developed countries to define 'elderly' or older people (WHO 2013). WHO also reported that the age ranges to define older people in western countries cannot be equated those in Africa, which they indicate the age of older people is starting at the age of 50 to 65 years. However, in many developing countries, the definition of 'older people' is used when one is making less active contributions and change in social role (role assigned) accompanying with physical decline (Gorman 1999). To date, there is no United Nations (UN) standard numerical criterion, but the UN agreed cut-off is 60+ years as a reference to refer to the older population (WHO 2013).

2.2.1 Statistics and Demographics for Older People

The UK population is ageing. The Office for National Statistics (ONS) has reported that there will be 24% more people aged 65 and over, and 39% more people aged 85 and over in England in 2021 compared to 2011. They also projected that in England, a 51% rise in those aged 65 and over; and a 101% growth in people aged 85 and over from 2010 to 2030 (Parliament 2013).

In almost every country, the results of the lengthening in life expectancy and declining fertility rates caused the rapid growth of the population aged over 60 years compared to another age group (UN 2001).

According to the Government Actuary Department and ONS (2011) (refer Figure 2.1), they have projected that older people (over the 60s) have begun to outnumber younger people (under 16), which massively happen in developing countries (WHO 2009). Asian countries show the highest proportion of older people, notably in Japan. In their studies, Park *et al.* (2012) reported that Japan has the oldest population compared to other developed countries. The phenomenon of 'baby boomer' generation, who were born between 1946 and 1964, is now entering their late life and become the larger population of older people in most western developed countries.

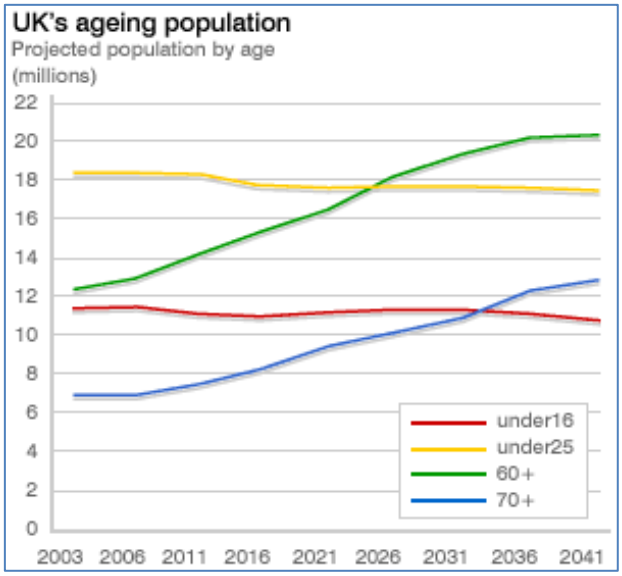


Figure 2.1 United Kingdom's ageing population (ONS 2011)

2.2.2 The Intended Target Group

This research was targeting older people between the ages of 55 and above. The main focus is older people aged 55 to 75 years old by taking into consideration the challenges faced by this target group, as discussed in Section 2.5. Gell *et al.* (2015) demonstrated that the use of technology among older people is closely linked to the younger people, such as it will reduce in proportion due to the greater limitations in physical function and disability. Also, 55 years old is considered as a good starting age (cut-off age). As people get older, they are more likely to suffer from age-related changes. Apart from that, this study should also consider

those who will fall into the category of older than 60 years old (standard retirement age) as they are the first group who are likely to use the technology.

Another reason for this is most people who are 55 had been exposed to the information technology compared to older respondents. Kooij *et al.* (2008) claimed that the people over the age of 50 are the fastest growing group of the workforce; where workers commonly using a computer to perform their daily tasks (Nord *et al.* 2006). After they retire from work, older people in this age range may have more time own their own, and may not be active (less physical and cognitive stimulations) and prone to feel socially isolated.

By looking further into the future, parallel with the rapid evolution of technologies in 5 to 7 year time, people within the chosen age group are familiar with information and communication technologies (particularly computer). The aged people will shift over time, from the age range of the 50s into 60s and this makes them more prepared and more tech-savvy.

2.3 Interaction and Experience

Interaction is a way of framing the relationship between people and objects designed for them—and thus a way of framing the activity of design (Dubberly *et al.* 2009). Edmonds (2007) defined interaction as a relationship between any input during certain interval will followed by certain output (predict). Manninen (2003) indicated the interaction forms as actions perceived by players, where the players can interact between players or between players and game environment. Game is more engaging when it allows interaction between the player and the game itself or with other players, and gaming equipment is used as a medium of interaction (Prensky 2001). According to Wilson *et al.* (2009), there are three types of interaction; (1) the equipment, (2) interpersonal and (3) social. Learning while playing the game can be interesting. This can be demonstrated when an 'equipment interaction' indicates how the player manipulates the game. For example, the player is allowed to pick up an object and manipulate it (i.e. punch it, swipe it). While interpersonal interaction shows the relation between players in the real world (acknowledge each other's achievement). The social interaction is the state when senses of belonging grow as interpersonal activity increases.

User experience (UX) is a subjective measure of the quality of a system seen from the users' perspectives (ISO 2010, Law *et al.* 2009, Nawaz 2014). UX can also be defined as "a person´s perceptions and responses that result from the use or anticipated use of a product, system or service" (ISO 2010). UX is "dynamic, context-dependent and subjective, and related to a broad range of potential benefits users may derive from a product" (Nawaz 2014).

In this study, UX was also defined as users' perceptions. It was used as a term to cover the usability, experiences, and preferences of older people regarding their previous experience in playing digital game and experience towards digital games used especially in this research study. To ensure a digital game is attractive and well received by the target group, positive user experience should be considered by the game developers.

With respect to game design for older people, studies showed that older people have specific gaming needs and preferences. It is also observed that their abilities differ from younger people (Gerling *et al.* 2010, ESA 2011, Pearce 2008, Nap, *et al.* 2009, Nacke *et al.* 2009). Thus, this research study focuses on the older people (user) specifically on how they interact and experience with digital games.

2.4 Older People and Technology

The Internet has changed the way older people go about their daily lives. In their studies, Kinsella and Velkoff (2001) reported that the percentage of computer usage among people aged 50 and above is continually increasing. This is proven in a report by ONS in 2012. The ONS (2012a) has reported that 80% of UK households, up from 77% in 2011 (increased by 3%). In May 2014, 43.5 million people in the UK had used the Internet, representing approximately 87% of the adult population (including older people). 73% of adults in the UK used the computer every day, which shown the rise from 45% in 2006 (ONS 2012b). This indirectly indicates the increase of computer users from all age groups over time (refer Figure 2.2) with the largest relative increase being for those aged 65 and over. In 2006, 9% of those aged 65 and over reported using the computer every day, compared to 42% in 2014 (increased by 33 %).

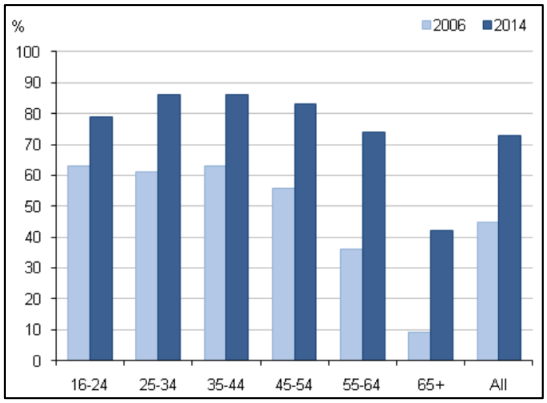


Figure 2.2 Daily computer use by age group, 2006 and 2014 (ONS 2012)

The problems of an ageing population are a growing concern for today's society where the growing numbers of older people around the world raise serious concerns towards pensions, health care, long-term care and other services. Studies by Takegawa (2005) show that the costs of maintaining the elderly have been rising in ageing Asia, particularly in East Asia.

The ratio of retired people to workers has increased, and it has caused high demand and need for medical care and caregiving services (Knickman and Snell 2002, Anderson 2014, Molinuevo 2008). Most of the service cares, especially for long-term care is very costly and this has become a financial burden to the family members, public health service and the government where they could not afford to cover all the expenses.

For that reason, the UK government offers to fund any researchers, institutions, and organisations to emerge with mechanisms to ease the issues above; which were to keep older people live a healthy life and self-sufficient, both for the quality of life and to contain the generated cost. The AgeUK carried various programmes to improve the quality of life of older people with the collaboration of the city council in every region in the UK. For example, in Coventry, the AgeUK together with Coventry City Council and the Age Research Centre (ARC-HLS) from Coventry University have organised a project called 'Age Friendly Cities'. The main objective of this project is to examine ways to reduce loneliness and isolation of older people in Coventry, and the project is part of the World Health Organisation's scheme. Responding to government's call, research targeted the older people become an opportunity for the researcher as the government is funding related initiatives. To date, the Deloitte Centre for Health Solutions (2015) reported that the Technology Enabled Care (TEC) programme under NHS is capable of providing cost-effective solutions and improve health outcomes. The TEC involves technologies such as telehealth, telecare and

telemedicine. These technologies enable better communication between the patients, carers and healthcare professionals (HCPs).

Recently, the rapid growth of projects related to older people is largely conducted in western developed countries such as in USA, UK and other European countries compared to developing countries specifically in South East Asia countries. For example in Malaysia, there are very few studies in the area of older people and ICT (Hisham and Edwards 2007a, Hisham and Edwards 2007b, Jomhari and Kurniawan 2007). Only a handful of studies were found using digital games specifically for rehabilitation and training purposes which focusing on older people (Shamsuddin *et al.* 2011, Singh *et al.* 2012). However, there were several studies on the applied game/game-based learning conducted in Malaysia. These studies were targeting the education sector as their primary objective (Latif 2007, Zin *et al.* 2009, Baharudin and Jamaludin 2009, Ibrahim *et al.* 2010, Mohamed *et al.* 2010). The majority of the research were targeting younger generation (children and adolescents) rather than older people.

2.4.1 Technology Acceptance among Older People

The use of technology in daily life is becoming an essential element to perform specialised tasks in various sectors. For example, military simulation was used for combat training and strategy purposes. Another example, as in engineering, architecture and construction, simulation was used to build robust civil structures. In health care, patients' health was monitored using technology (Blood pressure, CT scan, medicine intake). Apart from that, medical training also benefited from simulation and technology where it was used as an alternative method to convey and deliver knowledge. At present, technologies are used in a countless variety of ways and play an important role in human life. It becomes a mechanism to deliver, store and access information or data, especially in public services and entertainment. It also acts as a catalyst for new practices such as 'remote working'. In other words, technology has touched every aspect of life, making it easier, better and different, where it is not only limited to the younger generation but also to the older generation.

Age-related declines become the main issue among the older people, where it causes them to become physically and socially inactive (Hamilton 2009, James *et al.* 2011). However, this should not be a reason for older people to not to get active and participating in regular leisure activities.

In order to respond to the emergence of new technologies and their influence in daily activities, there has been an increase in the number of initiatives that are aiming to equip older people with the required skills, such as the use of the Internet. For example, in United States (US), SeniorNet (www.seniornet.org) was actively involved in teaching the older people to use a computer and other communication technologies. Mirroring US based initiatives; various other projects and research in the European countries were now focusing on improving and supporting the well-being and the quality of life of the older people. In the UK for instance, Age UK (www.ageuk.org.uk) plays a key role in serving the needs of the older people by providing information and advice, services, campaigns, products, training and research. An example of the training provided by the Age UK was the computer training courses which were conducted across the country.

Age UK (2013) and the UK Telegraph (Hutchison 2010) reported that emerging technology helps older people to keep in touch with their families, relatives and societies. For example, grandparents would get online just to be connected to their children and grandchildren. This can take place using video conferencing applications, such as Skype which can promote a sense of "closeness" in encouraging social interaction (Cardinaux *et al.* 2011, Kirk *et al.* 2010, Milliken *et al.* 2012, Judge and Neustaedter 2010). The technologies also reduce the digital divide among the intergeneration (Cheok *et al.* 2005, Khoo *et al.* (2006), Voida and Greenberg 2009, Derboven *et al.* 2012). Other studies show that Internet-based products and services managed to increase well-being and social inclusion for older people (Mubin and Mahmud 2008, Röcker *et al.* 2011, Gamberini *et al.* 2006, Gerling and Masuch 2011).

Figure 2.3 Age Invaders gameplay sessions (Khoo *et al.* 2006)

Figure 2.4 TranseCare Shopping Game (Derboven *et al.* 2012)

2.5 Digital Games and Older People

During the past decades, digital games have become a popular recreational activity among younger generation namely for children, teenagers and young adults. However, with the evolving and availability of new technologies, such as game consoles and mobiles (i.e. tablets, smartphones) which aimed for casual gamers, different target users have been considered including older people.

In 1996, Adler (1996) finds that 60% of computer owners aged 55 and above played computer games. According to Lenhart *et al.* (2008), 40% of Americans aged 50 to 65 play video games. A study of 1, 200 households by the Entertainment Software Association (ESA 2009) reports that 26% of video game players are men and women over the age of 50, and shows more than a quarter of the gaming population is over 50. In 2011, 29% of Americans over the age of 50 play video games, an increase of 20% from 1999 (ESA 2011). This figure shows the percentage of older people playing digital games via console or computer device is increasing year-by-year. While according to Ijsselsteijn *et al.* (2007), the rates of older people who played digital game vary and determined by the age groups and in different countries. For example, in the UK, 18% (approximately 1.7 million) of the 51 to 65 years old play digital games while 52% older people aged 65 and over play digital games in Finland (Pratchett 2005). This is particularly interesting as the marketing and design of digital games were often focused on young people in mind rather than older people. In fact, many older people who are interested in playing games and this is a promising area for developer and researcher to explore and invest more. On top of this, existing research reveals that age directly links with the amounts of money spent on virtual goods within social games. The older the gamer, the more they spend (Gaudiosi 2011). This is due to the older demographics have more disposable income than younger demographics.

As mentioned earlier in **Chapter 1** (**Section 1.1.1**), games should have a different level of difficulties to support individual preferences and sensomotor abilities (Weisman 1983). Thus Weisman (1983), Whitcomb (1990) and Ijsselsteijn *et al.* (2007) proposed several game designs and recommended an appropriate user interface for older people who emphasise on impairments in visual and auditory perception and a loss of sensomotor skill. In 2008, Flores *et al.* (2008) extended the above approaches by recommending the design of appropriate cognitive challenges, a simple user interface and provides feedback.

2.5.1 Health

In the health sector, there is an increased interest in digital games, and it has become a potentially effective tool to address health issues (Ma *et. al* 2014). The introduction of game-driven participation and maintenance mechanism for therapy can be motivating to the older people, which is important to generate cognitive and physical wellbeing. Gameplay has been introduced in a therapy session of dementia (Chavin 1991), Alzheimer's disease – one form of dementia (Cordrey 1994, Vallejo *et. al* 2017) and auditory hallucinations as well (Carter *et al.* 1996). The Eldergames projects, for instance, shows that healthy brains are caused by active minds and by using the state-of-the-art game design and production technique, it will be a catalyst for promoting the benefit of the games (Spagnolli 2006). Meanwhile, the HERMES project (Buiza *et al.* 2009) focuses on attenuating the older people memory decline using conventional gaming such as puzzles, sudokus and mazes.

Research shows that benefits of using games include increased attention span and hand-eye coordination, stress relief, slows down memory loss (or prevents it) and improved confidence and reducing the risk of falls by improving balance (Neufeldt 2009, CARDI 2012, Ellmers *et. al* 2017). A recent study found that a car-racing game called NeuroRacer (Abbott 2013, Iorfino, 2013), can help older people to improve their capacity to multitask and improved attention span for as long as six months.

2.5.2 Social Aspect

Besides that, the digital game has gradually become a social tool that can enhance relations between all players of all ages. Although the fact that digital games are often played as single player or alone, Jansz and Martens (2005) reported that many players would prefer to play with their friends or family. The reason could be because of the game environment allows and encourages gamers (friends or family members) to interact with each other in interesting ways. It also helps to enhance social engagement which nurtures teamwork and connectedness. Studies by Livingstone and Bovill (1999) and, Durkin and Barber (2002) documented that gaming can produce new bonds in particularly between a father and his sons. Other examples show that the digital games have positive social effects. Age Invaders, a project that aimed for age-related sensomotor deficits, offers different player roles and engage both younger and older players in the game (Khoo *et al.* 2006). Similarly,

DanceAlong project proposes to encourage dancing activities (exercises) and social engagement among older people and families (Keyani 2005).

Several other studies also indicate that age-related impairments influence the use of game among older people. These studies propose several game design considerations for older people (Romero *et al.* 2010, Gerling *et al.* 2012). With respect to game design for older people, studies showed that older people have specific gaming needs and preferences. It is also observed that their abilities differ from younger people (Gerling *et al*. 2010, ESA, 2011, Pearce 2008). De Schutter and Abeele (2008) propose that the game design should consider topics that are related to older peoples' real life experiences. Gerling *et al.* (2012) echoes De Schutter and Abeele's view by suggesting user experience and sufficient information needs to be examined and provided to capture adequate interaction between players and the games. Studies by Romero *et al*. (2010) however indicate that involvement by older people themselves throughout the design process is important to obtain valuable information in meeting their needs (the transactions of the ageing process that relate to their likes and dislikes). These studies indicate the importance of the andragogical aspects when it comes to designing and developing games, specifically for older people where Knowles' four principles of Andragogy are applied in the design of the studies (see Table 2.1).

Table 2.1 Knowles' 4 Principles of Andragogy (Knowles 1984)

Adults need to know why they need to learn something: Most learners want to know the reason why they need to learn something, or how it will benefit them. That is why learner needs to be involved in the planning and evaluation of their instruction.
Adults need to learn experientially: Learner learns based on experiences (including mistakes), which provides the basis for the learning activities. Normally adults want to use what they know and want to be acknowledged for having that knowledge (sharing experience).
Adults learn best when the topic is an immediate value: Learners are most interested in learning subjects having immediate relevance to their work and/or personal life.
Adults approach learning as a problem-solving: Adult learning is problem-centred rather than content-oriented. They want to see how/what they are learning will apply to their life, a task they need to perform, or to solve a problem.

2.5.3 Games for Serious Purposes

Considerable interest had been shown towards the learning process using digital games. The games that were designed and developed with this kind of purpose is termed as '*Serious Games'* (SG). There are various definitions of serious games such as any application developed using game technologies that is not specifically for fun or entertainment (Arnab *et al.* 2013, Zyda 2005, Michael and Chen 2005, Susi *et al.* 2007, Chaffin and Barnes 2010). In general, it can be referred as applications developed using interactive computer game technologies that serve purposes other than pure entertainment (Raybourn and Bos 2005). It has been effectively utilised in the defence sector, especially for military training such as *Virtual Battlespace 2 (VBS2)* and *Virtual Battlespace 3 (VBS3)* (BISim n.d.). There have also been simulation games developed for urban planning purposes, for example, the *Billstedt-Bürger-Beteiligung (B3) Game, Participatory Chinatown* and *SimCity* (Poplin 2011, MAPC n.d., Landa 2013). It also has been applied in several other sectors such as aviation, health care, industry, social networking and education. Also, Pavlas *et al.* (2010) implied that serious games are relatively similar to training simulations and differ from traditional computer-based training in term of delivery of knowledge, skills and attitudes via play.

Designing a suitable game, notably a serious game for older people is a challenging task for researcher and developer. There are many aspects that need to be considered when it comes to developing a game for older people. For example, the demographic of older people such as age, gender and mobility as well as to ensure it meets the needs and interests of older people. Besides that, the health issues and age-related functional limitation are among the main aspects that should be taken into consideration. Towards supporting the needs of the older people and the relevance of learning, the andragogical approach can be considered and applied. It is to have a better understanding of what older people think, how they see it and how they react to it. Further discussion on andragogy is presented in **Section 2.7**.

2.6 The Challenges Associated with Age-related Declines

Changes in psychological (i.e. depression), mental/cognitive (i.e. dementia, incontinence), physical (i.e. visual, auditory, motor control impairments) and social are inevitable and affecting the population as they grow older. Woolham *et* al. (2010) addressed that the number of people who respond with impaired sight, hearing or mobility very much affecting the tasks they would like to do are increasing with age (sight 55-64 = 34/8% 75+ = 67/19%; hearing

55-64 = 30/7% 75+ = 69/20%; mobility 55-64 = 93/20% 75+= 177/42%). They also reported that these deficits had brought an impact on a large number of respondents, especially in affecting their lifestyles.

While Grifitth *et al.* identified that the cognitive impairment and vision problem are among the five chronic ailments commonly affect people aged over 65 years. Studies show that social isolation affects older people with vision loss or impairment (Fletcher *et al.* 1991, Conrod and Overbury 1998, Dalton *et al.* 2003, Crews and Campbell 2004, Sloan *et al.* 2005), as well as loneliness (Smeeth and Iliffe 1998, Kaasa 1998, Hinds *et al.* 2003, Savikko *et al.* 2005). Other studies show that hearing impairment (Cruickshanks *et al.* 1998, Gates *et al.* 1990, Reuben *et al.*1998, WHO 2011) and; falls and hip fracture (Marks 2011, DTI 2007) were among the common problems experienced by the older people, aged 65 and over.

Based on their studies, Salthouse (2009) also reported that the cognitive decline is more likely to begin in the late 20s. Contrary to the Salthouse's finding, previous other researchers reported that cognitive decline begins later in life; at the age range of over 50 and beyond (Albert and Heaton 1988, Schaie 1989, Plassman *et al.* 1995, Aartsen *et al.* 2002, Rönnlund *et al.* 2005). Decline in memory and other cognitive abilities is a common feature of ageing and this is associated with lowered quality of life (James *et al.* 2011).

Despite the growth of computer usage among people aged 50 and above, Hannon and Bradwell (2007) identifies that the older people over 65 is not computer literate and also at risk to be digitally excluded compared to the younger group. However, Czaja (1996) stated that the older people are willing to try or use computers in various contexts but facing more difficulties than younger users. This is because they require more time to do a task, extra training and more help during the training sessions.

Alm *et al.* (2002) asserted that the major barrier for older people to the acceptance of new technologies, notably towards computer's usage is a lack of confidence. First-time users believed that the technology is difficult and not suitable for their age. This belief is also strengthened by their observation on the attitude of many younger people these days. This negative stereotyping of older people and those who are stereotyped by others (i.e. speed of movement) can bring a serious effect, which can be detrimental to their motivation and confidence (Alm *et al.* 2002).

Despite some initial difficulties in learning to use the technologies, many older people are beginning to enjoy the benefits that technologies can offer them. However, some people would also agree that when it comes to new technology, it is not usually designed with older people in mind. Next section will briefly discuss the teaching and learning strategies, which are pedagogy and andragogy, with a particular focus on the strategy that relates to the older people, andragogy.

2.7 The Andragogical Perspectives

Recent studies provided preliminary evidence that different age groups may think differently and make different decisions when it comes to the adoption and use of technology (Milliken *et al.* 2012, Judge and Neustaedter 2010, Cheok *et al.* 2005).

Different age groups mentioned in above research are between younger and older people. It is shown that the way adults learn or perceive their environment is different from children, therefore to promote learning for an adult will require a different approach. One of the main ideas in adult learning is by referring to the andragogical model.

By definition, *pedagogy* normally defined as a term of the art and science of 'teaching'; specifically for teaching children. Meanwhile, *andragogy* is the art and science of 'helping' adults learn, which is based on main assumptions among the two different learner groups; adults and children (Knowles 1984). Knowles promotes andragogy to distinguish between the different approaches used to teach and engage adults and children. Knowles presents six assumptions to differentiate the pedagogical model and andragogical model, which comprise of *the learner's need to know, experience, self-concept, readiness to learn, orientation to learning*, and *motivation* (Boulton-Lewis *et al.* 1996, Knowles *et al.* 1998). Table 2.1 presents Knowles' 4 Principles of Andragogy adapted from (Knowles 1984) and Table 2.2 shows the comparison of pedagogical and andragogical assumption adapted from (Knowles *et al.* 1998)

These andragogy principles (Table 2.1) can be used to inform the design of an effective technology-based learning for adults' learner. With the integration of adult learning theory, lessons created will meet students' needs in learning about technology and also fulfil their requirement as an adult learner. The andragogy model highlights adult motivations for learning and argues that adult has different motivations and reasons for learning as well as

learning activities must be purposeful. This will also bring the question on the acceptability of technology (game-based learning) among older people.

Table 2.2 Comparison of Pedagogical and Andragogical Assumptions (Knowles *et al.* 1998)

2.8 Andragogy and Technology

To date, there were several researches, which had been carried out to show the adult learning approach or andragogy can be integrated into technology-based learning. Demirbilek (2010) suggests an effective way for teaching and learning and discusses on pedagogical approaches using digital games. As adult learners have different learning styles than children learners, the author has offered guidelines to facilitate the use of andragogy while teaching and learning through digital games. To apply digital games in online adult education, the author suggests that adult educators should fully utilise the guidelines provided in order to meet the needs of all adult learners.

Demirbilek also believed that the digital games bring benefits in adult education by motivating and engaging the learners. Specifically, using the game based learning compared to conventional learning environments can help both adults (educators and learner) in

learning new concepts, acquiring expertise and practising knowledge as well as to immerse in real-life simulations. The study also discusses on the overview of current perspectives on adult learners.

Demirbilek indicated ten advantages using digital games in online adult training which were based on previous research. Several examples provided were digital games can attract and motivate learners; reinforce developing certain skills; reinforce inclination to co-operate and enjoy learning, encourage positive interactions among the learners; make training more meaningful and fun; as well as adding a competitive element to the learning environment.

The author claimed that most of the adult learners seem unmotivated and do not show interest. This is the biggest challenge in teaching adults through online training. Therefore, the Andragogy theory (Knowles' 4 Principles of Andragogy) is used to overcome the challenge by taking into consideration these four principles*; (i) adults need to know why they need to learn something; (ii) adults need to learn experientially and digital games provide a far greater variety of experience than any textbook exercise; (iii) adults approach learning as problem-solving and (iv) adults learn best when the topic is of immediate value*.

Demirbilek studies can be as a starting point for another researcher in the similar area, to use the guideline given in order to achieve a successful outcome of teaching and learning using digital games. Adult's learning styles are different compared to a child learner. Based on the study, Andragogy Theory is adopted in order to meet the needs of adult learners.

Other studies that mirror the study by Demirbilek include Wang and Kania-Gosche (2011) and Roberts (2007). The authors also demonstrated that andragogy approach should be used in assessing adult learners using technology-based learning, either using games or online environment. These types of practices and the adaptation of andragogy theory can be implemented in developing a digital game, especially for older people. This is not only resulted in technologically workable solution but also effective from the adults learner's perspective. When distinguishing both serious games and computer games, Zyda highlights that serious game (which is more than just a story, art and software) is an addition of pedagogy (educate or instruct, in the way to convey knowledge or skill) that makes games serious (Zyda 2005). Zyda also suggests that in the story, the entertainment components come first while the pedagogy acts as a subordinate to story. In this research, andragogy theory was used to focus the design and development on older people, opposed to pedagogy which is very generic that normally focused on children and adolescent.

2.9 Summary

Based on this part of literature review, a conclusion can be made on the level of acceptance towards the technology by the older people. Not all older people refused to use/accept the technology. In fact, they are eager to use technology in their everyday lives, which can bring greater independence, improve well-being and quality of life. For example, the use of assistive technologies (e.g. product design approach) such as telehealth, telecare and robot could provide helpful resources in term of independence maintenance (Dishman 2004), personal assistance to older people (Nortman 2000) and health care (Camarinha-Matos and Afsarmanesh 2004).

The game industry is currently experiencing rapid growth in terms of clients/users and the number of sectors that implementing it as a tool. The implementation of serious games brings a big impact on learning needs in military, education and healthcare sectors. It has become a potential market due to the ageing population is increasing and the use of serious gaming for engaging people with serious purposes and meaning. As been mentioned earlier, it is essential to captivate and engage the users by using the game before any serious purposes/objectives can be imposed. Therefore, this study highlights the importance of understanding the interactions (relationship between user/older people and game designed) and experiences (perceptions and perspectives given after playing games). Also, this study look at how andragogical perspectives and the understanding of challenges associated with age-related will help in design a digital game for older people.

In the next chapter, this study continues by understand how existing games and serious games were designed and what frameworks and models that can be used to frame the investigation of this study. In order to support the older people with challenges faced mentioned earlier (refer **Section 2.6**), there are several specific attributes based on existing frameworks and model will be identified. By taking into consideration of learners' learning ability (where the andragogical perspectives are applied) and identifying several important attributes in game design, purposely-built game that targeting older peoples can be designed and developed properly. This design should consist of suitable attributes aimed at older peoples' requirements and specifications.

CHAPTER 3

GAME DESIGN FRAMEWORKS AND ATTRIBUTES

Chapter 3 presents a continuation of findings established from reviewing literature that are relevant to the research. Section 3.1 discusses the introduction of game-based learning frameworks and model that become research references. Four selected frameworks and model are listed; and the similarities and differences of the frameworks and model are discussed in Section 3.2 and Section 3.3, respectively. Section 3.4 discussions on game mechanics/attributes of a research study leading to a discussion on design considerations based on four relevant criteria in Section 3.5. Lastly, Section 3.6 summarises the chapter.

3.1 Introduction

Numerous numbers of frameworks and models already exist that focused and used in designing games (Garris *et al.* 2002, Hunicke *et al.* 2004, de Freitas and Oliver 2006, Gunter *et al.* 2008, Winn 2009). Some of these frameworks and models are particularly used to design a game for the general type of games (commercial games), such as the Mechanics, Dynamics, and Aesthetics (MDA) framework by Hunicke *et al.* (2004). Several other frameworks and models emerged from earlier research to enhance and support the understanding of the games. These frameworks and models are usually aimed at designers, academics and specifically at practitioners to support the effectiveness of the games and to help avoid inconsistencies in game-based learning (Barab *et al.* 2005, Mustaquim and Nyström 2012). However, some of it lacks the design directions, and often missing pedagogical perspectives. The Relevance, Embedding, Transfer, Adaption, Immersion and Naturalisation (RETAIN) model by Gunter *et al.* (2008), Four-Dimensional Framework (4DF) by de Freitas and Oliver (2006) and Adaptive Digital Game-based Learning Framework (ADGL) by Tan *et al.* (2007) are frameworks and model that were proposed to design games, specifically for educational driven-based games (game-based learning and serious games). All of these frameworks and models have been designed to evaluate the integration of technology into teaching environment.

MDA, RETAIN, 4DF and ADGL are the four frameworks and model selected as the main references for this research study and thesis. Descriptions and components of each framework and model will be discussed in the next section.

3.2 Selected Frameworks and Model

3.2.1 Mechanics, Dynamics, Aesthetics (MDA) Framework

The MDA framework was designed by Hunicke *et al.* (2004) to "…clarify and strengthen the iterative processes of developers, scholars and researchers alike, making it easier for all parties to decompose, study and design a broad class of game designs and game artefacts".

This framework consists of three interrelated components; *mechanics, dynamics* and *aesthetics*. Figure 3.1 depicts the relationship between the designer and the player. The designer designs the mechanics or formal rules of the games. The run-time behaviour of the game or the dynamics is formed when rules are instantiated during playtime and influenced by the player's inputs. Meanwhile, the aesthetics describe the emotional responses or pleasure evoked in the player.

Figure 3.1 MDA Framework (Hunicke *et al. 2*004)

These three components needed to come out with the dynamic behaviour of game systems, perceive games as dynamic systems in supporting the development of better design and ways to improve by giving full control to the player to choose what they require (i.e. desired outcome and tune to desire behaviour).

Mechanics, dynamics and aesthetics can be defined as follows (Hunicke *et al.* 2004):

- The mechanics can be analysed by looking at or reading about the game. It is a synonym to the 'rules' of the game and can be in the form of agents, objects, elements and their relationships in the game. Mechanics also defined game as a rule-based system, specifying what is in the game, how it behaves, and how the player and the game interact with each other,

- The player can discover the dynamics when playing and analysing how gameplay evolves over various play sessions. The dynamics are behaviour that arises when applying the games mechanics in motion (player input during game play), (i.e. *How two players interact with one another?* and
- The feeling or emotional responses from the players to the gameplay while playing reforming the aesthetics. It is more to the effects that the dynamics have on the player and do not refer to the visual (graphics) elements of the game only. (i.e. *Is the game 'fun'? Is the play emotionally or intellectually engaging?*).

The MDA framework has proven to be a useful approach towards designing and analysing gameplay. However, it is only focusing on the design of games in general, which is meant for commercial games (entertainment) and does not concern on educational driven-based games (game-based learning). Thus, it is important to look at MDA framework as a guide in designing and development phases and can be utilised to build player feedback into development.

3.2.2 Relevance, Embedding, Transfer, Adaption, Immersion and Naturalisation (RETAIN) Model

RETAIN model describes high-level methods and tools are neither comprehensive nor explicit in terms of how the learning components and game components are related to one another as well as the relationship optimisation process. It proposed to design a game for the game-based learning environment and used to identify important elements of the game and instructional design. It also addresses an abstract level of learning, such as the cognitive, affective and psychomotor learning domains, without targeting an actual outcome-oriented learning context specifically. RETAIN comprises of six components, which are (Gunter *et al.* 2008):

(i) *Relevance*: presenting and ensuring the learning content are relevant to learners' previous learning experience,
(ii) *Embedding*: assessing how closely the learning content is coupled with the fantasy/story content,
(iii) *Translation*: how the player can use previous knowledge and apply it in other domain,
(iv) *Adaptation*: a change in learning activity as a consequence of transfer,
(v) *Immersion*: the player intellectually invests in the context of the game, and

(vi) *Naturalisation*: the development of the habitual and spontaneous use of information derive within the game.

RETAIN is a combination of John Keller's ARCS Model of Motivational Design and Gagne's Nine Levels of Learning used to identify important elements of the game and the instructional design. Gagne's nine events of instruction show how to integrate these objectives into an instructional design and how to sequence instruction to provide an effective hierarchy of learning (Gagne *et al.* 1992). The Keller's ARCS model identifies attention, relevance, confidence and satisfaction for motivating instruction (Keller 1987). These instructional, motivational factors must be integrated into game design elements to produce an engaging educational game which ensures the academic skills are acquired after the gameplay.

3.2.3 Four-dimensional (4DF) Framework

The Four-dimensional Framework (4DF) was developed by de Freitas and Oliver (2006), to explore complex learning goals by prescribing games to be designed with the considerations relevant to the traditional learning context. This framework consists of features that were common in serious game design framework, which are: *the student, the teacher* and *the tools/resources available* (de Freitas and Oliver 2005). Later, the fourth feature; the representational issues of the game world is included to create the four-dimensional framework. It consists of four dimensions (de Freitas and Oliver 2006):

(i) Emphasis on the attention to pedagogy (e.g. learning methods, models and mechanics),
(ii) Emphasis on the learner profiling (e.g. demography, ICT skills, gaming experience),
(iii) The required amounts of fidelity, interactivity and immersion in the representation of the game (e.g. game concepts, game engines, mode of deployment, level of fidelity, interactivity), and
(iv) The consideration of the context within which learning takes place and plays an important role in shaping learner expectations (e.g. disciplinary context, blended or standalone, place of learning, formal or informal).

By following the four dimensions model, game developers should be able to design serious games by taking into account the learners' learning characteristics, the different pedagogical and contextual constraints so to support effective learning, stimulate reflection on knowledge

and transfer learning into the real world environment. **Figure 3.2** shows the Four-Dimensional Framework (4DF).

Figure 3.2 Four-Dimensional Framework (4DF) (de Freitas and Oliver 2006)

3.2.4 Adaptive Digital Game-based Learning (ADGL) Framework

Derived from three frameworks and models by (Embi 2005, Barendregt and Bekker 2004, Said 2004, Amory 2001), Adaptive Digital Game-Based Learning Framework (ADGL) was proposed by Tan *et al.* (2007), which identifies another six additional elements needed in designing game-based learning environment. This framework discussed and proposed components that provide leverage to the pedagogical aspects of designing game-based learning environment (Tan *et al.* 2007). These elements are divided into two main aspects *Learner* and *Game Design*, where both have several elements as shown in **Figure 3.3.**

Figure 3.3 Adaptive Digital Game-Based Learning (ADGL) Framework (Tan *et al.* 2007)

Derived from the analysis, Tan *et al.* (2007) describe that ***learner*** requires:

i. *Psychological needs* – the way of learners act and behave depending on what they think and react which can satisfy their needs, learners will engage and continue to play games when their needs are fulfilled

ii. *Cognitive Development* – human cognitive development is different based on several factors such as age and demographic. Thus, to design a game that meets the learner's needs and interests, it should base on their demographic and achievement.

iii. *Learning behaviour* – it can be difficult to identify a learner's needs. However, it is important to make sure the effectiveness of the game and meet the desirable learning outcome

On the ***game design aspect***, the authors stated the requirement as follows:

i. *Multimodal* - consists of modality and interaction features such as multimedia elements and interface design. It helps to ease the interaction between the learner and the game

ii. *Task* - helping learners to absorb the learning content. Game is designed with different levels and degree of difficulties to engage the learner to continue to play and learn

iii. *Feedback* – is vital, it provides clues and hints which given directly or indirectly to the learners

Tan *et al.* (2007) also stated that a well-designed game-based learning should consist of elements such as story, challenge, goals and objectives.

Appendix 9 shows the brief descriptions of components above for different game-based learning frameworks and models.

3.3 Similarities and Differences between Frameworks and Model

As discussed in **Section 3.1**, all frameworks and model were used for designing the digital games. Therefore, these frameworks and model were selected due to the differences of the components in each of the frameworks and model. Each component plays an important role and complements each other in order to make sure the developed game is up to the standard, as well as meeting the needs and preferences of the intended group. The main outcome of this

comparison is to propose a new framework by referring to the existing frameworks and model that have been selected and compared.

This study found that the MDA framework is a general framework for game design (particularly for general type of games - commercial games) and the other three (RETAIN, 4DF and ADGL) are frameworks and model meant for developing educational based game, using pedagogical approaches. None of these frameworks and model were meant to be used to design games with the specific interest of the adult learner (andragogy), especially older people.

4DF proposed a framework to explore complex learning goals by prescribing games to be designed with the considerations relevant to the traditional learning context. Although this framework is normally used for assessing and evaluating the serious game and not particularly for design, the researcher has started to use it for game design and development process. For examples, 4DF has worked well and tested as a supporter to other immersive experience in virtual worlds (de Freitas *et al.* 2010). While Arnab *et al.* (2013) developed a game, PR:EPARe (*Positive Relationships: Eliminating Coercion and Pressure in Adolescent Relationships*) that aims to assist the delivery of Relationship and Sex Education (RSE) in secondary schools curriculum. PR:EPARe design process was based on the correlation between 4DF and MDA frameworks. Meanwhile, the ADGL framework identifies elements that provide leverage to the pedagogical aspects of designing game-based learning environment.

These frameworks and model have listed several important attributes to be considered when designing a serious game. However, none of them provides a guideline in designing serious games for older people. Game attributes will be discussed in more detail in **Section 3.4**.

3.4 Game Mechanics/Attributes

As explained in **Chapter 2, Section 2.2.2**, positive rate of older people using technology in their daily life can be observed, not limited to only performing tasks at the workplace but also in other fields such as education and health-related training. The evolution aims not to alter the objective of training, but to increase efficiency by taking advantages of the new technology (Gordon 2003). Researchers noticed that the effects of using technology, which is in this case by using digital game-based training could lead to better understanding of general

learning, higher motivation and improve performance (Michael and Chen 2005, Prensky 2001, Rencrantz 2003).

Similarly, Fletcher and Tobias (2006) in their findings show that games are increasingly used in education and training tools over the past decades. With regards to the online learning environment that include game-based learning, Demirbilek (2010) reports that learning through gaming activities can bring relaxation and motivation to older people as well as steering the social interaction and connectedness among the class member as well as with the educator. However, not all games are fit for learning (i.e. education, training) purposes. For example, Kraiger *et al.* (1993) stated that instructional gaming is effective for training use only when the game attributes match the desired learning outcome. Vary attributes are required in every single different case, based on the intended learning outcome of each serious game. A subset of the instructional attributes should be present to ensure that games can be an effective learning delivery (Wilson *et al.* 2009, Lameras *et al.* 2016).

Based on finding from various publications (conference papers and journals) of existing game attributes, this research study chose the most cited publications available, with regards to the models and frameworks for serious games. This also included attributes from four chosen frameworks and model (MDA, RETAIN, 4DF and ADGBL).

There are various types of game attributes introduced by researchers in these past years. In 1987, Malone and Lepper highlighted that *challenge, curiosity, control* and *fantasy* as the main elements in games (Malone and Lepper 1987). Meanwhile, de Felix and Johnson (1994) suggested that games should consist of four components, which are *dynamic visuals, interactivity, rules* and *goal*. Prensky (2001) recommended six structural factors that should be included in the game which are (i) *rules*, (ii) *goals and objectives*, (iii) *outcomes and feedback*, (iv) *conflict/competition/challenge/opposition*, (v) *interaction* and; (vi) *representation or story*. Furthermore, Derryberry (2007) also indicated few more game attributes such as *backstory and storyline, game mechanics, rules, immersive graphical environment, interactivity, challenge/competition* and *risks and consequences*.

In 2009, Wilson *et al.* discussed a subset of attributes: *fantasy, representation, sensory stimuli, challenge, mystery, assessment* and *control* (Wilson *et al.* 2009). Later, Flores *et al.* (2008) suggested a criterion of games which is focused on elderly entertainment that include appropriate *cognitive challenge, simple objective/interface, element of social activity,*

appropriateness of genre, creation of new learning and *sensitivities to decreased sensory acuity and slower responses*.

Little consensus is made on how these characteristics are described. Gariss *et al.* (2002) state that different terms and approaches are used by different researchers when describing similar game characteristics. Thus, from this research, the review of game attributes made by Wilson *et al.* is arguably the most comprehensive in the literature and very helpful in determining potential learning outcomes for the games. For the purpose of this study, findings by Wilson *et al.* is expanded, and some attributes are suggested which are believed to have an impact on older people. Game attributes and definition that adapted from Wilson *et al.* is summarised as in **Appendix 10** and work by Lameras *et al.* (2016) referred to map learning attributes to game mechanics.

As these attributes form the crux of any digital game that is suitable for older people, it is important to examine them in more detail. A typical digital game with a purpose will not necessarily contain all these attributes. Therefore, few attributes were examined during the focus groups. As a result, several attributes were identified from data analysis which was more specific to the older people.

Based on the review of the literature, several potential game attributes are incorporated and identified for the use in designing a suitable game for older people. *Rules/Goals, Assessment, Challenge/Conflict, Ergonomics, Interaction* and *Sensory Stimuli* are the selected attributes proposed in this study. These attributes might differ depending on the analysis of the finding (the most or frequently selected by older people from series of focus groups). The next section will briefly review each of the attributes selected for designing a game specifically for older people. Description of each proposed attributes are summarised in Table 3.1.

Table 3.1 Game Attributes for Designing Purposely-built Game Focus on Older People

Attribute	Definition	Related research
Rules/Goals	Clear rules, goals on progress towards goals	Malone, 1980, 1981; Lepper & Chabay, 1985; Thurman, 1993; Pavlas et al., 1999; de Felix and Johnson, 1994; Ricci, Salas, & Cannon-Bowers, 1996; Prensky, 2001; DerryBerry, 2005;Garris et al., 2002; Wilson et al., 2009; Bedwell et al., 2012
Assessment	The measurement of player's achievement within game	Chen & Michael, 2005; Garris et al., 2002; Wilson et al., 2009; Pavlas et al., 1999; Bedwell et al., 2012; McLaughlin et al., 2012
Conflict/Challenge	Problems and combination of nature and difficulty of the problems. Can be the motivator in gaming, can be presented with uncertainty, multiple goals, randomness and ambiguous information	Crawford, 1984; Owen, 2004; Garris, Ahlers, & Driskell, 2002; DerryBerry, 2005; Flores et al, 2008; Wilson et al., 2009; Pavlas et al., 2009; Bedwell et al., 2012; McLaughlin et al., 2012
Ergonomics	Optimise performance and enhance the productivity. Promote active interaction among people, technology and the environment in which both must operate.	McLaughlin et al., 2012
Interaction	The interaction between player and the game itself or with other players; and gaming equipment are used as a medium of interaction. Three types of interaction: interaction (equipment), interaction (interpersonal) and interaction (social)	Crawford, 1984; Prensky, 2001; Wilson et al., 2009; Pavlas et al., 1999; McLaughlin et al., 2012; Bedwell et al., 2012
Sensory Stimuli	Dramatic or novel visual, auditory and tactile stimuli	Garris, Ahlers, & Driskell, 2002; Hereford & Winn, 1994; Lepper, 1985; Wishart, 1990; Malone, 1980, 1981; Rieber, 1991; Thurman, 1993

3.4.1 Rules/Goals

According to Wilson *et al.* (2009), a well-defined game consists of well-defined rules and guidelines which steer the player to the goals, which is the expected learning outcome of the games. Rules and goals are among attributes that frequently been mentioned in other studies de Felix and Johnson (1994).

Rules/Goals related to mechanic components in MDA framework indicates that the internal processes and requirement of games (challenges of and players' interaction). Core mechanics normally consists of rules, objective, conflicts and procedures. According to Gerling *et al.* (2012), the player needs to learn certain aspects of core mechanics such as restriction caused by rules before they can master a game. Issues faced by older people are highlighted. In this context, the decline in memory function will cause the limitation of learning, and the learning process will require more time. Therefore, in designing a game for older people, the game rules, objective and the procedures have to be clear. Also, it needs to be simple to understand and relevant to their daily life which can facilitate the learning processes. Rules/goals are also related to the learner specification element in 4DF. This element is applied to study the learners and their needs, which at the same time ensure the interaction between the learner and the environment (de Freitas and Oliver 2006). Rules/goals attribute is represented as *relevance* components in RETAIN and *learner psychological needs* in ADGL are also similar to the *relatedness* of the 4DF element.

When adopting these attributes in designing a game for older people, it should be precise, clear, simple and easy to understand. The player which in this case is older people might need more time to understand the technical aspects of the game. For example, searching for help and exploring the game features and functions. This meets the assumption of Knowles' Andragogy Theory which stated that the adults need to learn experientially. In this case, a certain game will have specific goals that tied to a task that might require the player (older people) to use their prior knowledge to achieve the goal. The goal must be clearly specified, and the player knows what to do to complete the task. For example, a game on introducing the solar system, the player is required to answer all the names of the planet, and the answer must be in a correct order. Meanwhile, Rollings and Morris (2003) argued that the rules are applied during the gameplay to give some challenge in term of game restrictions and constraints. Take the same example as before; rules can be implied as the use of time limit (timer) imposed during the answering session. A player is given a certain amount of time to respond to the question to make his/her moves.

A set of goals and rules in the game will also increase the motivation of player to learn and continue to play. Malone (1981) agrees that motivation levels of participants are increased when the game had a clear and well-defined goal. Besides that, these attribute indirectly aims to foster collaboration between players and become a method to ensure the older people

actively engage in socialising. This can be done by setting up a set of rules and goals that create the situation where the players are dependent to one another to achieve the goal.

3.4.2 Assessment

Assessment (i.e. feedback, debriefing) is important for game design and vital to learning, as it provides a measurement of the player's achievement (Salas and Cannon-Bowers 2000). In the context of this study, achievement considerations are to increase motivation level towards learning and to improve older people's' retention in playing. Effective and constructive feedback is needed to sustain engagement and belief can assist the player to identify mistakes or errors at the same time providing recommendations to improve learners' understanding. This will also increase the learners' confidence and motivate them to stay on the task.

Based on the literature and the process of critical thinking, providing positive feedback to the older people will steer them to self-enhancement. This will ensure them to learn from their actions (i.e. mistake and error) and adjust performance accordingly. Older people preferred to know and learn the connection between their actions and the outcomes. This shows that the older people are self-directed. According to Hanna *et al.* (2000), self-directed is referred as establishing own learning goals and activities that are required to a learner in learning environment.

Wilson *et al.* (2009) suggest that to have an effective feedback, assessment of performance need to be specified such as 25 out of 50 questions are correct and timely (frequent update during the game). Rewards can also be given to learner in the game, and this can help in evaluating learner's assessment. For example, the learner is encouraged with the rewards and this will boost their confidence to continue and complete the next task.

3.4.3 Conflict/Challenge

In games, conflict/challenge is referred as problems and combination of nature and difficulty of the problems. The challenge is specified to be the motivator in gaming and also can be presented with uncertainty, multiple goals, randomness and ambiguous information Malone (1981). Due to the unpredictability nature of the challenge, gaming can maintain players' motivation and retention. However, if the challenge is too easy or too hard, it will lead to frustration and boredom. This will lead the players to lose their interest to continue playing.

Wilson *et al.* (2009) suggest that the ideal amount of difficulty or challenge should match the player's abilities to the skills required to achieve the goals. This attribute is important in designing a game for older people, with regards to providing an endless challenge as a way to engage them to play and motivates them to learn. Challenges in the game can also foster interaction among the player, such as the social games that serve as virtual teamwork training tools. When players have to challenge each other in the game, intensive interaction occurs which will bring closeness and connectedness.

Conflict/Challenge is related to the aesthetic element of MDA framework that adds fun and competition in the game. Conflict/challenge also related to task component in ADGL framework, however, no related characteristic found in RETAIN model and 4DF framework.

3.4.4 Ergonomics

Ergonomic, in general, is used to optimise performance and enhance the productivity, as well as to support people and ensure they are safe, healthy and comfortable (Springer 2007). In this research, the main ergonomic focus is to promote active interaction among people, technology and the environment in which both must operate.

Good ergonomics can also increase a person's ability to use information and perform tasks. Based on finding by Lee *et al.* (2014) on smartphone usage among people over 55, the authors addressed the issues of the font size, brightness of the interface, how do they arrange it (buttons, icons), the delay time for the input and feedback. These are among the important components been discussed and related to older people. From the cognitive aspects, Lee *et al.* (2014) also documented on the style of learning among older people because their learning process is different (i.e. player types, learning styles). Another finding from Lee *at al.* mentioned about the cost (e.g. the game), where some of the older people unwilling to spend their money on games. Some of them have a lack of confidence using technology, especially when using a smartphone. Previously, they learn about computer and the use of the internet. However, studies showed that older people had been slower in adopting computer and using the Internet (PEW 2012). Now, they try to move from computer to smartphone, and it showed that today's older people have been slow in accepting and switching to a smartphone. This might be because of the size of the smartphone (bigger screen) and the ease of use of the touch screen functions.

The challenges faced by older people and the game aesthetics were also being considered. Crawford (1984) reported that games offer a safer way to explore the reality to the older people. In particular, older people will experience and discover unusual situations without risking own life or property, where the freedom to act without fearing real-world repercussions exists. For example, older people with mobility disability once again can enjoy gardening or learn new cultures and places without the need to travel. Gardening and travelling are represented in a virtual environment that mimicking the environment of a real world without worrying the limitation they had. The implication of andragogy assumption was referred; older people are motivated to learn by internal factor and ready to learn when they know something that relevant and beneficial to them.

The interaction aspects were also being taken into consideration. There were several researchers listed these attributes in their research such as presented in ADGBL. In ADGBL, interaction belongs to game design aspect which falls under *multimodal* (**Section 3.2.4**). The interactions keep older peoples' attention (the learner) as well as motivating and engaging them during the gameplay session. Older people realise that the usage of the game as training and learning tools can increase motivation which is correlated with maintaining the cognitive ability and physical capability. Games can be used to present information in an innovative and interesting way. Therefore, the next section discusses the interaction; one of the proposed attributes in this research study.

3.4.5 Interaction

The game will be more engaging when it allows interaction between player and the game itself or with other players, while the gaming equipment can be used as a medium of interaction (Akilli 2007). According to Wilson *et al.* (2009), there are three types of interaction, which are an interaction (equipment), interaction (interpersonal) and interaction (social). Interaction (equipment) indicates how the player manipulates the game. For example, the player is allowed to pick up an object and manipulate it (i.e. kick it, throw it). Interaction (interpersonal), however, is the relation between players in a real environment and it allows the player to acknowledge each other's achievement and at the same time player's involvement increased when there are more challenges. Lastly, interaction (social) is the state when senses of belonging grow as interpersonal activity increases Wilson *et al.* (2009). This

normally occurs in massively multiplayer online games (MMORPG) (Galarneau and Zibit 2007).

Elements from MDA framework have been used in almost every proposed attribute for the research. Once again, the aesthetic is related to equipment/ interpersonal/ social interaction attribute. Here, the consideration of the interaction representation is taken into account, to generate interaction between the player and the environment as well as with the other player. Equipment/ interpersonal/ social interaction related to the learner specification in the 4DF framework, and also related to multimodal (interaction components in ADGL framework). However, equipment/ interpersonal/ social interaction is not being considered in RETAIN model.

The equipment/ interpersonal/ social interaction are among selected attributes that were considered in designing a game for older people. This is based on the review of challenges faced by older people. This can be seen in a scenario when an older people is incapable of playing the guitar because of his disability or impairment (eye-hand coordination problem, physical illness) or he/she has never learned how to play. The experience (own experience or from observation) he/she has from the real world will be brought and performed into the virtual world (fantasy). Games also promote social interaction (multiplayer games, competition) and transfer of knowledge among family members and friends (andragogy perspective).

Interaction is needed to promote active social interaction during the gameplay session. The fear of taking part when it involves new technology could be among the challenges that cause the older people to be not interested in technology apart from low self-confidence (i.e. interact, try new thing, involve in activities) in dealing with it. Therefore, interaction is needed to ensure that the older people have more confidence when interacting with others as well as with the technology (especially computer). While the game is being played, older people will be encouraged to work together (team-based) where collaboratively working together can stabilise strategies more rapidly than playing as a single player.

The andragogical perspective of this attribute will allow the learner to learn a new thing. Besides that, the attribute also encourages active social interaction among learners and emphasising cooperation and togetherness between them. When player's team is given a task, sharing experience among the team member could occur and creates a positive environment.

This attribute is important because older people need to be more active in interacting socially, especially to inculcate social inclusion and confidence towards the use of the technology.

3.4.6 Sensory Stimuli

According to Garris *et al.* (2002), the sensory stimulus can be defined as the visual or auditory stimulations which distort perception and imply temporary acceptance of an alternate reality. Some games can be attention grabbing when it involves unfamiliar or strange dynamic graphics (visual), sound (auditory), or vibration on the controller (tactical) stimulations (Malone *et al.* 1987). For example, a loud sound of ringing metal and vibration in the controller may occur when a ball hit the goal post. The stimuli effects sometimes are used to enhance fantasy Wilson *et al.* (2009) as well as deliver feedback for performance (Malone 1980). The addition of interactive gaming characteristics leads to greater cognitive learning (Vogel *et al.* (2006) that combines the sensory stimuli and other gaming attributes.

The inclusion of the sensory stimuli in designing a game for older people could bring realism effects in the gaming world (i.e. auditory – sound of avatar's actions and voices, visual – wave topples onto the beach). It also fosters engagement and motivation to the players, especially older people with disability and impairments to continue playing. Consider an example where older person with visual impairment is trying to play a digital game. He/she can play the game just by following the voice instructions and tactile stimulation that represent by vibration in the controller. Similarly, instruction via texts or images based and the addition of tactile stimulation is a better approach to those who have a hearing problem. The representation of these sensory stimuli in a game for older people will ease the player understanding especially to those with disability and impairment. Based on andragogy perspectives, older people prefer to learn something that incorporates metaphors of daily life and easy and simple to learn.

Aesthetic component from MDA framework is applied to Sensory Stimuli attribute where the fantasy and challenge characteristics are presented. These characteristics will make the game interesting in term of the realism for both learning and the gameplay. Sensory stimuli is related to embedding in RETAIN model, internal representation world in the 4DF framework and finally, multimodal (modality) in ADGL framework. The andragogical perspective of the game mechanics stems from this attribute highlights the interactive representation of the

game. The main objective is to encourage the older people to stay engaged and motivated to continue playing the game.

3.5 Design considerations based on Four Quadrants (*User, Context, Representation and Theory)*

With regards to the game design approach, the four quadrants (*user, context, representation* and *theory*) are adopted by this research and based on the research findings from Hunicke *et al.* (2004), Gunter *et al.* (2008), de Freitas and Oliver (2006) and Tan *et al.* (2007). The four quadrants were selected based on the findings from the previous sections and game mechanics/attributes listed in Table 3.1. The *user* specification links to the subject (player) and the *theory* along with the *representation* links to the *context* to form a tool in the development of digital games for older people. These four quadrants play an important role and complement each other. They also can be tailored to support study's investigation (refer next section) where it can guide the researcher in the development phase.

3.5.1 User

This quadrant mainly discusses on the user (here an older people) and certain factors such as age, gender, socioeconomic and culture which can influence their perceptions and perspectives. According to Mayes and De Freitas (2004), digital games and simulations could offer support to a user with diverse abilities and skills. Thus, *user* quadrant is included in their framework. By focusing on the user interaction and experience (perceptions and perspectives), a purposely-built game can be personalised to support the target group, which is the older people.

3.5.2 Context

The *context* quadrant focuses on the environment, in particular, where the location of gameplay by taking into account the method of the delivery, system support, resources available and the moderator background. Bayley *et al.* (2009) indicated that context is important to understand the user's needs and preferences which can become the factors for

learning support or provide a problematic weakness in the digital game due to lack of research in this area. After addressing the contextual issues such as the location of the gameplay, the digital games can be developed into a suitable environment, such as a home or care home environment.

3.5.3 Representation

The *representation* quadrant refers to the diegesis and technology of the digital game (using the console (gesture-based) and tablet (touch-based)) in which the player engages in the gameplay activities. De Freitas and Jarvis (2006) asserted that *representation* is one of the most significant areas to be highlighted as the player immersion alongside critical self-reflection techniques (experience: fun, motivation, and interaction: natural or unnatural interaction perspectives) are an essential representation of the game content. In *representation* quadrant, issues of player immersion and fidelity, game-based technologies and uses, interactivity (social interaction, interpersonal interaction, interaction with equipment (i.e. natural or unnatural interaction)) as well as usability studies need to be considered in the digital game development. The game attributes and mechanics as identified earlier in this study (refer Table 3.1) showed the mode of representation and believed to suit and can be used in the game, especially in designing game targeting older people. Besides that, the aesthetic values such as feeling effects (i.e. fun, angry) and graphical designs are arguably two of the most important elements in the games. As mentioned earlier, aesthetic does not only focus on graphical design (it provides visual rewards to the players) but also conveys powerful messages (effects) to the players when being used strategically.

3.5.4 Theory

Theory quadrant focuses on the theories used, how the theories are applied (in gameplay sessions); and how the theories can be supportive to the player, other players (player group) and the game environment. In any purposely-built games, the theory is an essential to validate the game and to make sure the contents are appropriately embedded and the objectives are achieved. As mentioned earlier (**Section 3.1**), some frameworks have already been designed to guide the development of the serious game and learning applications in general. However, these guidelines are covering digital learning in general and not designed for older people specifically. Thus, by combining four quadrants from existing frameworks and the adult

learning theory (Knowles *et al.* 1998), this study proposes to develop a guideline that can cater the creation of digital games, specifically for older people.

3.6 Summary

This chapter looked into four different game-based learning frameworks and model which are; the Mechanics, Dynamics, Aesthetics (MDA) framework by Hunicke *et al.* (2004), Relevance, Embedding, Transfer, Adaption, Immersion and Naturalisation model (RETAIN) by Gunter *et al.* (2008), Four-Dimensional Framework (4DF) by de Freitas and Oliver (2006) and Adaptive Digital Game-based Learning Framework (ADGL) by Tan *et al.* (2007) that were reviewed, referred and selected for the use of this study. This chapter also identified several game mechanics/attributes and this leads to the discussion on design considerations based on four quadrants: *user*, *context*, *representation* and *theory*. These quadrants will be used in analysing the data at the later stage. The following chapter discusses on the research study methodology such as the research design that is referred throughout the study, procedures taken for recruit participants, methods of data collection and data analysing.

CHAPTER 4

RESEARCH METHODOLOGY

This chapter describes the specific methods and methodologies adopted in this research, for instance, the research design, participant recruitment, participants' demographic and procedure of data collection and data analysis. This chapter is outlined as follows; Section 4.1 presents the background, leading into a discussion on why the mixed-methods research was applied as a feasible method for this research followed by elaborates on the research design. Section 4.2 and Section 4.3 discusses the study population and the study area. Section 4.4 presents the research recruitment method while the following sections, Section 4.5 and Section 4.6 elaborate on the measures and procedures concerning the data collection used in the project. Section 4.7 describes and explains the data collection types then followed by data collection techniques and the analysis methods are presented in Section 4.8 and Section 4.9, respectively. Section 4.10 describes the procedure of data protection followed by the ethical approval process in Section 4.11. Finally, Section 4.12 summarises the chapter.

4.1 Research Design

According to Creswell (2012), there is a tendency to design research based on individual beliefs, cultural presuppositions and discipline-related epistemological factors that influence the researcher's decision to approach research following either the quantitative or qualitative paradigm. However, the selection process needs to be in line with the overall scope of the research, the philosophical stance of the researcher and the nature of the data gathered and analysed.

Bryman and Bell (2012) defined research design as providing the framework for the collection and analysis of data, while Sounders *et al.* (2009) defined research design as the general plan to answer the research question, which contains clear objectives from the research question. Meanwhile, Creswell (2012) defined research design as a specific procedure involved in the research process, consisting of data collection, data analysis and report writing. Creswell also categorised research design into three categories, which are quantitative, combined (mixed) and qualitative research.

In quantitative research, a research problem is identified based on trends or the need to explain the reason of certain occurrences (Creswell 2012). Here, the numbered data can be analysed using the statistical method. In contrary, the qualitative research can be addressed as the research problem with unknown variables that need to be explored. Creswell and Clark (2011) define mixed methods research design as a process for collecting, analysing, and mixing both quantitative and qualitative methods in a single study or a series of studies to understand a research problem. Based on Greener (2008), data collection can be enhanced and endorsed by using triangulation of quantitative and qualitative methods in a particular study. For instance, a survey is deployed to gather data in larger scale and subsequently generalises the results, while interview helps to provide themes or areas for an in-depth investigation of a few individuals.

The design of the research conducted for this study adopted a concurrent mixed methods design using triangulation method research approach, exploiting a combination of qualitative and quantitative methods as the overarching investigation instruments. It was selected as a means to offset the weakness between the two methods, result in well validated and substantiated findings. The rationale behind using this research design is to improve the effectiveness of data collection and to detail the research information obtained from different angles and perspectives. Besides that, this approach helps to assess the acceptability and usability of the design framework for data collection (Creswell and Plano Clark 2011), and indirectly will add-on to the credibility of the research findings (Creswell and Miller 2000).

Furthermore, concurrent data collection is less time consuming compared to the sequential designs. This is because the data collections of quantitative (i.e. survey) and qualitative (i.e. group discussion) are concurrent, happening at the same time of the study (Creswell 2013). It also involves data collection from different sources of information that would enable a researcher to make comparisons (i.e. between different groups) and determine the areas of agreement as well as areas of divergence (Guion 2002). It also helps to re-emphasise the aspects of interaction and experience by linking it with four quadrant elements, which would be the key to clarify methods, instruments, measures and analysis in this study. For this study, the sources were from the older people participants (retirees, full-time employed, part-time employed, self-employed and unemployed) and literature review. Questionnaire and focus group were conducted with all participants to gain more insight into their perspectives on the phenomenon under study.

The data collection techniques or multiple sources used to gather data for this research study are listed as follows:

i. Qualitative: Focus group/group discussion, gameplay and observation
ii. Quantitative: Questionnaires

The description of each method is shown in Table 4.1. Refer **Section 3.7** for details and further description. By using both combinations of techniques, it enables the researcher to validate the data through triangulation and cross reference (Merriam 1998).

Table 4.1 Data collection techniques

Methods	Description
Focus Group/ Group Discussion	An interview with participants (older people), who were involved in the project
Gameplay	Demonstrate existing games to the participants by giving them the opportunity to play games and familiarise with the functions and the features of the platforms used
Observation	Observe the process of the gameplay and group discussion session
Questionnaires	Conduct survey by distributing a questionnaire to the participants to gather appropriate data (i.e. demography background, technology usage)

Figure 4.1 illustrates the research design. It consists of four key stages to allow a rigorous investigation into the research problem and questions.

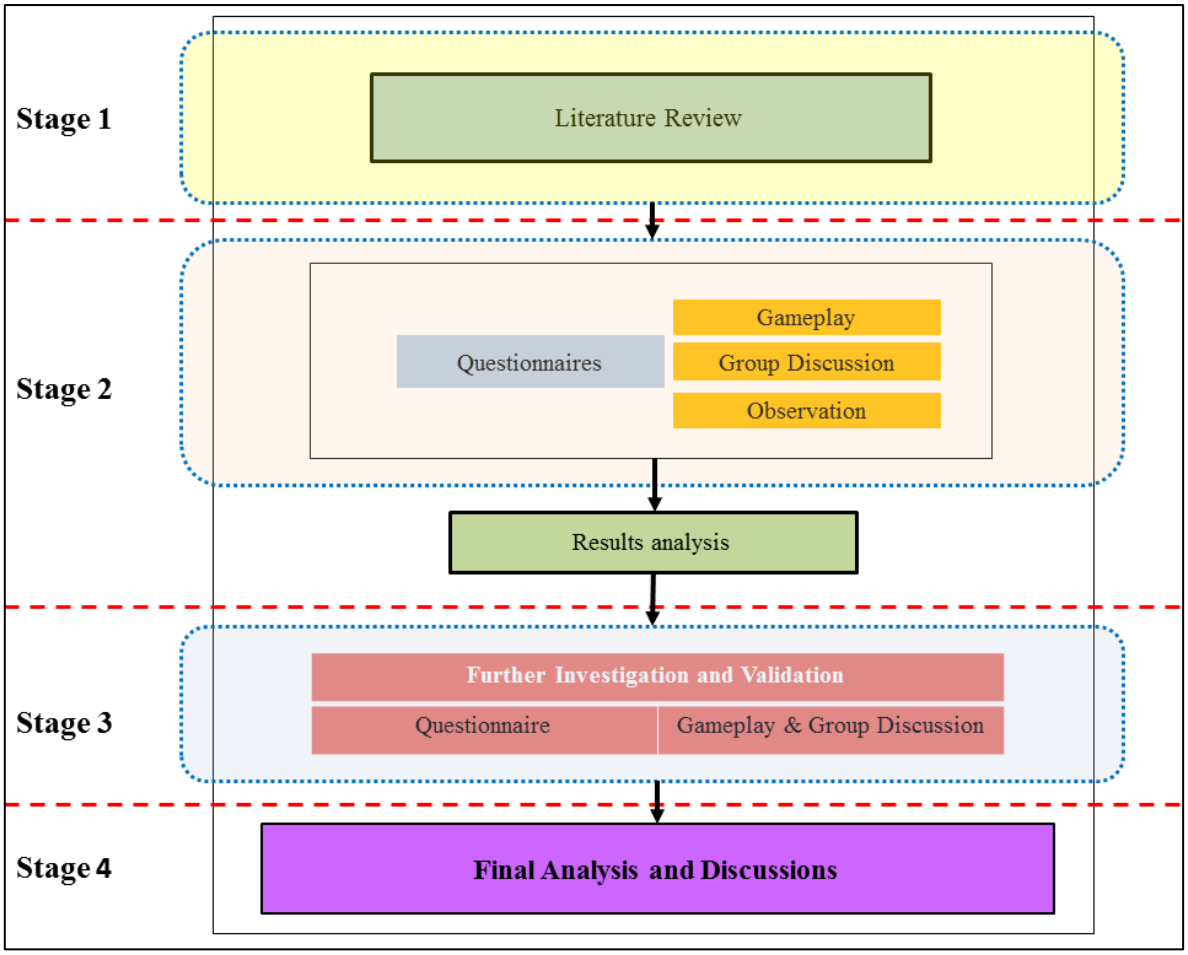


Figure 4.1 Research Design

In **Stage 1**, reviews on the several kinds of literature were conducted. These reviews focused on the key topics, contents and domains that highlight the influencing factors and considerations in new technology development, specifically targeting the older users. The reviews focused specifically on the human computer interface design, game design, andragogical perspective and the age-related challenges faced by the older people. Existing work and related studies were extracted, analysed, synthesised and discussed. The findings are discussed in Chapter 2 and 3. It is of utmost importance to set a clear context to refine and validate the game design and the attributes considerations. This stage (**Stage 1**) helps to investigate and identify any relevant strengths and weaknesses in the previous research. In a nutshell, this stage enables us to understand the current key issues of the research and its significance towards the research domain. Also, it enables us to identify the current related works for comparison purpose.

In **Stage 2**, the game design considerations and attributes concerning user interaction and experience were investigated, and the subsequent hypotheses on the key considerations were

defined. This was carried out through an iterative process of focus groups consisting of administered questionnaire, gameplay, observation and group discussion (which includes the validation). A series of focus group (*Preliminary study*) were conducted to discuss the user interaction and experience. These focus group sessions enabled us to obtain the information on the design considerations and attributes (users, contexts, representation, and theory) based on the participant's interaction and experience with digital games. Data findings were derived from this stage and further investigated in **Stage 3**.

Meanwhile in **Stage 3**, further investigation was conducted based on findings derived and informed in **Stage 2** (Phase 1: Preliminary Study). Two tests were carried out:

i. Test 1: Disseminate questionnaire – to gather more relevant data with regards to user's demographics, user's perception and usability towards technology specifically digital games which link to the 4 quadrants used in this research
ii. Test 2: Focus Group - consists of gameplay and group discussion

These tests were carried out to stringent and deepen understandings of the previous findings, which had been derived and informed in **Stage 2**.

Finally, in **Stage 4**, the analysis is conducted to synthesise the research findings, contribution and potential further works. During analysis and interpretation phase, results from both methods (quantitative and qualitative) were integrated. The results highlighted the convergence of the findings to strengthen the knowledge contributions of the study.

4.2 Study Population

A population can be considered to be the target group from whom the researcher wants to know and learn something. Polit and Hungler (1993) described an accessible population as the cases that meet the criteria and accessible for the study. A maximum of 100 participants (taking into consideration potential drop-outs) who are living independently, physically and mentally active with no serious illness (e.g. severe heart disease, need intensive care) within the aged of 55 and above have been recruited for this research.

The main target group is within the age of 55 to 75. The reason for such categorisation is to help us to have a better understanding of the older people and their age-related challenges. As presented by previous researchers (Roger and Mynatt 2003, Zhang and Kaufman 2015), the

technology acceptance can be increased (among older people) through a gradual introduction to older people who are still active and highly functioning (e.g. in their 50s and 60s). Also, the support provided by the technologies can be viewed beneficial by the older people as their individual abilities decline. This situation generally occurs when they are in their 70s and 80s. The reasoning behind the intended age group has been elaborated further in **Section 2.2.2, Chapter 2**.

4.3 Study Area

The general population for this research is in the UK. However, the focus group is based in Coventry (including Coventry & Warwickshire), a city and metropolitan borough in the county of West Midlands in England. Coventry is the 12th largest city in the United Kingdom. The data were collected from various groups and forums in Coventry and Warwickshire. The selection was influenced by the locality and the existing collaboration (direct or indirect) with the Age UK Coventry, Coventry University's Age Research Centre or Coventry's Older People's Partnership. In Phase 1, a series of focus group were conducted, and participants recruited only from Coventry. Meanwhile, in Phase 2, survey and focus groups were used to gather data. The survey was administered worldwide, however due to lack of participants from other countries (refer **Section 6.3, Chapter 6**) only data from UK respondents were accounted. Similar to Phase 1, focus groups participants in Phase 2 were also recruited only from Coventry. Having a reason several participants were recruited from the earlier phase and the study was based in Coventry.

4.4 Recruitment

There are several methods that can be used in recruiting focus group; *purposive sampling, convenience sampling* and *snowball sampling*. Purposive sampling is a method of extending knowledge by deliberately selecting sample participants who are known to be rich sources of data or capacity and willingness to participate in the research (Robert 1997, Oliver and Jupp 2006). Convenience sampling is a non-probability sampling technique where participants are selected because of their convenient accessibility (i.e. patients of a particular doctor or medical clinic, or employees of a particular organisation). Meanwhile, snowball sampling is a method where participants are recruited into the research, based on a referral from other participants (Davis *et al.* 2013).

For this study, a combination of convenience and snowball sampling methods were used. Recruitment of participants was formed by using pre-existing groups or organisations. Snowball sampling was utilised in this study when the initial participants, who attended the first session identified other participants who were then recruited to the following studies. These methods were selected because this study is focusing on a specific target group (older people). Is it also convenient for us to recruit participants from pre-existing groups, forums and organisations. Besides that, these pre-existing groups are well-managed in the UK (Coventry and Warwickshire) and have a substantial number of members that can be recruited as participants.

There are two participant recruitments phases for this research study. Refer **Section 4.6**.

i. First recruitment phase was carried out from July 2014 – November 2014
ii. Second recruitment phase was carried out from November 2015 – March 2016

Groups, forum and organisation that were approached are *the Senior People's Forum of Warwick District at Leamington Spa* and *Research Volunteer Support Programme (RSVP)* group from Applied Research Centre in Health and Lifestyle Interventions (ARC HLI), Faculty of Health and Life Sciences (HLS), Coventry University, *Older People in Action (OPA), Leamington Spa* and *Coventry's Older People's Partnership* and *Grumblesmile*s, *Coventry Healthy Walks*, Coventry City Council and *Cheylesmore Good Neighbours* the *Age UK Coventry*. With the help of researchers from the Faculty of Health and Life Sciences (HLS) and Health Design and Technology Institute (HDTI), Coventry University, a list of contact person from different groups and organisations was obtained. Table 4.2 shows the list of the organisation, group and forum approached, together with their location for this study.

During both recruitment phases, most organisations, groups and forums were approached via circulation of formal electronic mails (emails) with basic research's descriptions along with an electronic version of recruitment flyer. A number of participants were approached face-to-face at the Coventry Market (this was for second recruitment phase). This research study covers participants with mixed demography (e.g. gender, age and ethnicity) in order to provide a range of data for analysis.

Table 4.2 List of organisation, group or forum

Organisation/ Group/ Forum
1. Research Support Volunteer Programme (RSVP), Applied Research Centre in Health and Lifestyle Interventions (ARC, HLI-HLS), Coventry University
2. The Cheylesmore Good Neighbours, Coventry
3. Neighbourhood University- Coventry Healthy Walks, Coventry City Council
4. Health Design & Technology Institute (HDTI) - database of older people
5. The University e-dition (message of the day), Coventry University
6. Faculty's representative, Coventry University
7. The Age UK Coventry
8. Coventry Healthy Walks, Coventry City Council

More than 40 participants had originally signed-up for this study. However, half of the participants had to withdraw due to personal reasons, such as work commitments and not residing in Coventry. A total of 24 participants, who live in Coventry participated; 14 participants from Phase 1 (Preliminary Study) and 10 participants from Phase 2 (Further Investigation Study). Therefore, the total amount of participants in this study (specifically for focus group sessions) did not represent the general/entire population as described in probability sampling (Teddlie and Yu 2007). Thus, this study also conducted an online survey which was planned as one of the means to recruit more participants in Phase 2.

Prior to the focus group session, all participants were contacted in order to confirm their participation and to make an arrangement of their availability (i.e. date and time). Once the confirmation was obtained from the participants, a reminder via email or short message service (SMS) was sent. A day prior to the focus group, a second reminder was sent via email and phone to remind and for them to confirm their attendance.

As mentioned above, in Phase 2, an online survey was also used to reach more participants and to gather more data from the specific target group (aged 55 and above). The survey taking place from November 2015 through February 2016, and was conducted online with several respondents who preferred to fill it physically (on paper). For this study, the majority of the respondents were recruited via email although some respondents were approached face-to-face at the Coventry Market. A formal email (call for participants) was sent to the

existing contacts, namely friends, families, colleagues, pre-existing groups, forums and organisations (refer Table 4.2). Refer **Appendix 7** for the list of all approached participants. The recruitment was also done via website recruitment (i.e. Age UK Coventry, The older gamers (TOG)) and social media (i.e. facebook, twitter, LinkedIn). 100 respondents have successfully filled in the survey. Refer **Section 4.6.5.2.**

4.5 Measures

As described in **Section 4.1**, two main studies were conducted; *Preliminary Study* and *Further Investigation Study*. These studies employ mixed methods which are a combination of qualitative and quantitative approaches. Mixed methods approach was selected because the data collection was carried out within the same time frame and the finding results reported. The findings were merged and synthesised as a whole for larger understanding and reported in the final analysis (Creswell and Clark 2011). In this research study, the mixed methods were used to inform user's interaction and experience in playing digital games. Results from the findings will help to access the user's perception and usability of the design consideration targeting older people. Next section will discuss further on quantitative and qualitative measures used in *Preliminary* and *Further Investigation* studies.

4.6 Procedures

The Preliminary Study was carried out with 14 participants from July 2014 to November 2014. Meanwhile, Further Investigation Study was carried out with 10 participants recruited for focus group sessions (November 2015 to March 2016) and 100 respondents successfully filled the online survey (November 2015 to February 2016).

4.6.1 Number of Participants Required

Four focus groups were conducted, with each group meeting one time. This is in-line with (Krueger 1995, Morgan 1997), where the authors suggested a minimum of four focus groups are required or more if it is deemed needed to reach data saturation. Also, the authors suggested that each group should meet once to avoid redundancy and time wasting. This study limits the number of participants in each focus group session to four people. This is due to difficulty managing more than three older people and taking into consideration auditory

impairment, which could affect the participant's attention and the ability to follow the discussion. This is in-line with the suggestion by (Inglis *et al.* 2002). However, none of the participants reported having any form of disability or requiring any special attention during the focus group sessions.

Having a smaller group allows better participatory and contribution from all the participants. At the same time, it eliminates the 'nervous' and 'shyness' factors for the participants to be involved in the discussion. Furthermore, a smaller number of participants are easier to manage (with regards to discussion flow) and also enable greater in-depth discussion to reach data saturation. Based on (Lines and Hone 2002), a larger group (i.e. more than ten people) can become uncontrollable and the time constraint will limit the participant's opportunity to share their insights.

4.6.2 Length of Session

Several researchers have suggested various lengths of the session. Both Easton (1999) and Hupcey *et al.* (2004) stated sessions with older people typically lasted for 90 minutes or less, or approximately an hour. Typically, this study conducted focus group session for 90 minutes. However, there were sessions that lasted longer due to the participants 'eagerness' during the discussion and the gameplay session. There were also sessions conducted less than 90 minutes, due to the participant's fatigue situation. This study did not want to risk the potential health issues (i.e. fatigue and anxiety) among participants during the focus group sessions.

4.6.3 Location and Setting

The sessions were organised in a private room, teaching room and meeting room at Coventry University (e.g. Coventry University Library, Disruptive Media Learning Lab (DMLL)) and also several other venues provided by the group, forum or organisation. This is to ensure the convenience for the participants to join the session. In consideration of accessibility and familiarity, we also conduct our sessions in several well-known community sites such as the Age UK Research Centre where most of the older people normally gathered. These venues were selected based on the travel distance, which is within 30 minutes to 1 hour travel time

for the participants, with critical consideration of having an adjacent parking and the availability of the public transport to the venue.

Loeb *et al.* (2006) reported that it is vital to provide a venue that is comfortable, suitable and easily accessible for the older people interaction. Thus, the participants seated at a roundtable setup or positioned to have eye contact with other participants or the moderator. This seating position is required during the session with the objective of reducing the potential dominant members dictating the discussion. Also, it helps to facilitate discussion and accommodate/support impaired older people. Participants were informed and fully aware that the session was being video and audio recorded. Prior consent was also obtained.

4.6.4 Chosen Games

Several games that are considered suitable games for older people are selected. Selections of the games were made through games evaluation process. This is done by reading articles reviews and suggestions on the internet, videos browsing on YouTube and downloading free games or demos online (e.g. Google Play, Windows Phone Store, Apple Store). In Phase 1: Preliminary Study, four different commercial and casual games were chosen, which are *Kinect Sports*, *Kinect Sports: Season Two*, *2048* and *Traffic Racer*. Meanwhile, in Phase 2: Further Investigation Study, two games were also selected, namely *Dr Kawashima's Body and Brain Exercises for Kinect* and *Peak – Brain Training* (iOS/Android brain training app). All game is chosen due to identified different game attributes that are deemed important to this research project.

Each game was chosen for a reason (see explanation below) as well as to trigger different reactions from the participants. This could have affected the outcome of this research study. Choosing different games might change the findings of this study.

4.6.4.1 *Kinect Sports and Kinect Sports: Season Two*

Bowling and *skiing* games are two chosen games from the "Kinect Sports" and "Kinect Sports: Season Two". There are twelve others sport within these two commercial games. All sports stimulate movement and activity in a fun and motivating way. These games offer both cooperative and competitive plays and can be played in two modes; single player or multi-

player. These games were chosen because of its ability to entice excitement and also it imitates real movement in a particular sport. Figure 4.2 shows the two chosen games.

(a) (b)

Figure 4.2 Screenshots of (a) bowling, and (b) skiing in "Kinect Sports" and "Kinect Sports: Season Two"

4.6.4.2 *2048*

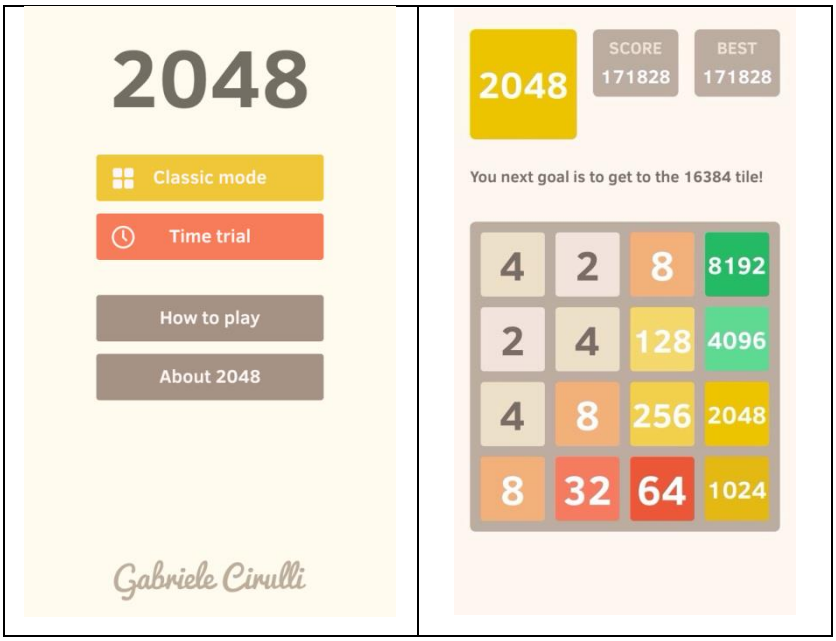


Figure 4.3 Screenshots of 2048 game

Figure 4.3 shows the screenshot images of *2048* game, which is selected as one of the games that have been played during the focus group session. This game is a single-player puzzle

game and represents a 2D graphical user interface. This game aims to slide numbered tiled on a grid to combine them and create the 2048 tile. The game will be different from any puzzle games that participants normally play. It is simple and fun yet very challenging puzzle game. Participants can choose either to play the original 'Classic Mode' or with 'Time Trial' mode that is built to challenge player reflexes and quick-thinking abilities.

4.6.4.3 *Traffic Racer*

Figure 4.4 Screenshots of *Traffic Racer* game

This game is a single-player game and presented in an interactive 2D graphical user interface. The aim of this game offers an unprecedented level of driving enjoyment. It is an endless driving game with different game modes.

This game was chosen due to its ability to facilitate enjoyable experience and it is fun to play. It also has the challenge (compete) function and also it imitates real driving environment at the same time. It is a straightforward and offers friendly approach that could create an enjoyable time for players.

4.6.4.4 *Dr Kawashima's Body and Brain Exercises*

This game offers a myriad of mini-games based on five categories – maths, memory, logic, physical-related exercises and mental reflexes questions in single and multiplayer modes. For the purpose of this research, several mini-games were utilised from each game. From *Dr Kawashima's Body and Brain Exercises* mini-games that were selected are as follows:

- *Traffic Control* (Physical) – This game requires both body movement and actively stimulate player's mind. In this game, player needs to make a 'bridge' using their arms to make sure colour coded cars and trucks make it to their correct colour coded ramp across the screen

Figure 4.5 *Traffic Control*

- *What Time Is It* (Logic) – This game also requires both body gesture and brain stimulation. The interaction aspects found in this game was the player needs to move their arms to match the time that was shown on the screen. This game offers body movement that leads to exercise and at the same time stimulate user's brain to process the information of shapes and numbers quickly

Figure 4.6 *What Time Is It*

- *Math Jock* (Math) – Similar to previous games mentioned, *Math Jock* also requires a combination of body movement and brain stimulation. The player needs to interact with the system by kicking the soccer ball with the correct solution to match the math problem that was shown on the screen. Then, the player will complete the math equation by kicking the numbered ball into the correct solution. The purpose of this game is to train the brain to perform arithmetic operation quickly and body movement simultaneously.

Figure 4.7 *Math Jock*

4.6.4.5 Peak – Brain Training

This game challenges individual cognitive skills based on different categories, including memory, focus, attention, problem-solving, mental agility, language, coordination, creativity and emotion control. The *Peak* is a single player mode. Nonetheless, the player could also compete with their friends and compare stats among each other. On the other hand, selections of mini-games from *Peak- Brain Training* game are as follows:

i. *Smile On Me* (Emotion Control) – A brain training game which enables the player to encourage interactions that could lead to building a relationship with other people (i.e. grandparents and grandchildren, friends). The player was required to tap only on the smiling faces (few images of people were showed on the screen) and avoid negative stimuli (i.e. sad, angry faces). Player could experience stress reduction and self-confidence after playing the game

Some materials have been removed due to 3rd party copyright. The unabridged version can be viewed in Lancester Library - Coventry University.

Figure 4.8 *Peak: Smile On Me*

ii. *Square Number* (Problem Solving) – In this game, the player was required to select square numbers which equal to the number that was displayed on the screen. The aim was to perform summation (arithmetic operation) to the total number displayed on the screen. It will begin with an easy and small number (2 numbers). As the game continues and getting harder, the player was required to select three numbers which sometimes includes an extra operation of subtraction. The game tests the player's arithmetic skill (problem-solving) and at the same time challenges player (mental agility) to quickly match numbers to achieve the highest score in a given time (countdown time from 1 minute and 10 seconds)

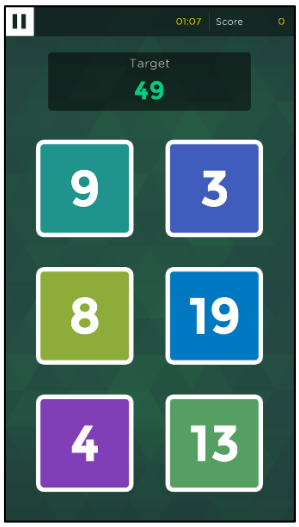


Figure 4.9 *Peak: Square Number*

iii. *True Colour* (Mental Agility) – Brain stimulation was the main objective of this game. It begins by giving instruction to the player to look at the name of the Colour versus the Ink Colour. The players were given 45 seconds to answer as many as they could. If the written word matches to the colour, the player was required to select 'Yes'. If otherwise, selection of 'No' was required instead. Figure 4.10 shows an example view of this game. For this example, the answer was clearly 'Yes' as the word "Yellow" has the correct ink colour. This game seems easy. However, it requires much focus. As player continuous to play, it is possible for a player to get easily confused and accidentally press 'No' when the player means 'Yes'.

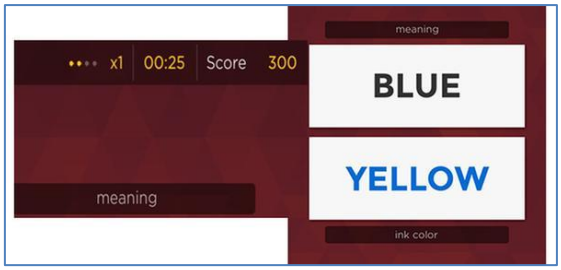


Figure 4.10 *Peak: True Colour*

4.6.5 Research's Studies and Components

This research consisted of two main studies which were; 1) *Phase 1: Preliminary Study* and 2) *Phase 2: Further Investigation Study.*

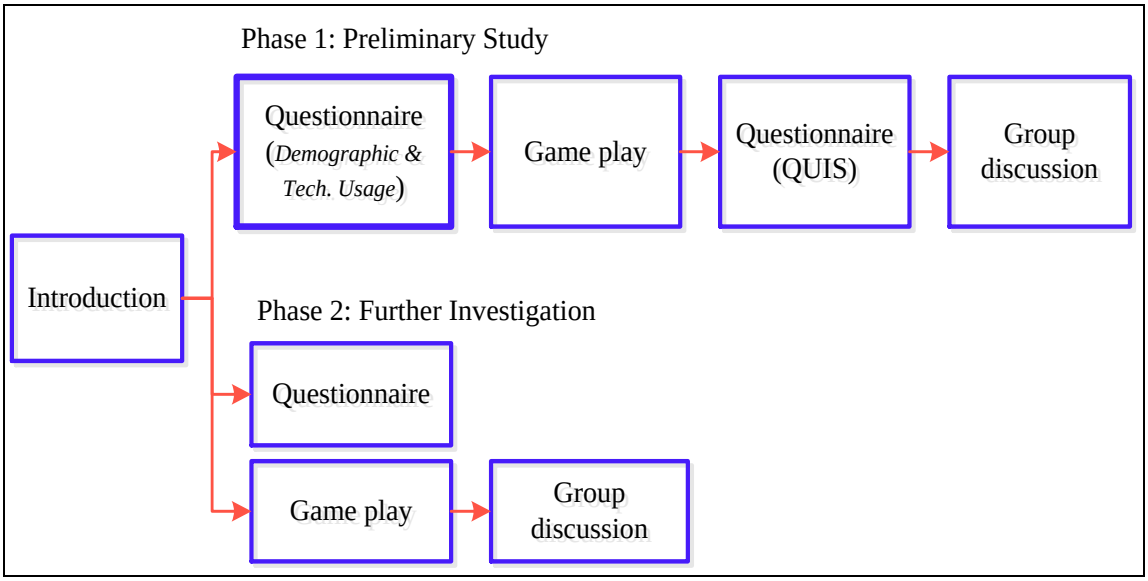


Figure 4.11 Focus Group Flowchart for - *Phase 1: Preliminary Study* and *2) Phase 2: Further Investigation Study*

Figure 4.11 shows the flow diagram of this research study focus group's activities. It is derived and modified from work by Upton et al. from the University of Worcester, United Kingdom titled *Evaluation of the Impact of Touch Screen Technology on People with Dementia and their Carers Within Care Home Settings* (Upton *et al.* 2011). The research setting was adopted because it has a proper and clear guidance (e.g. topic guided interview, focus group moderator guide), detailed tasks and activities in every sequence. Besides that, it has been used in conducting a focus group for the similar target group range, which is older

people. In advance, the flow of the focus group was planned and the listed agenda was informed to the participants prior to to the focus group session. Refer **Appendix 11.**

4.6.5.1 Preliminary Study

In the *Preliminary Study*, four focus groups were carried out with a total of 14 participants (n=14). The average age of participants was 65.04 (MEDIAN: 61-65). Each group consists of 4 people. Group 1 (FG1) consist of four participants, all female. Group 2 (FG2) consists of three males and one female participants. Group 3 (FG3) consists of three females and one male participants. However, Group 4 (FG4) only consists of two participants, one male and one female participants. Two participants withdrew due to personal reason. **Refer Section 5.3**.

There were two moderators for each focus group session, with the main researcher being one of them. The other moderator, who was well-informed on the study act as the assistant to the main researcher.

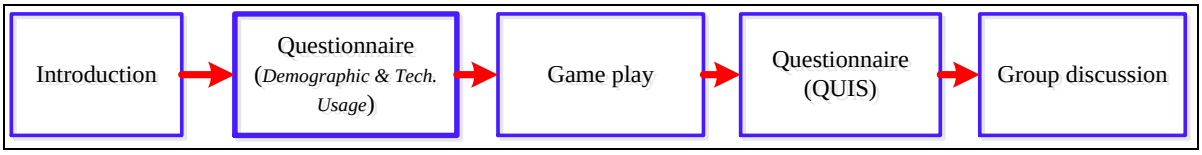


Figure 4.12 *Preliminary Study*: Focus Group Flowchart

Figure 4.12 shows the flow of *Preliminary Study* activities. In a nutshell, the activities consist of the gameplay, questionnaire, observation and semi-structured discussion. The following paragraphs discuss these activities in detail.

Introductory session: Ice-breaking session is conducted to introduce the moderators and welcome the participants. Every participant was given a brief description of the focus group's main purpose, which is to investigate design attributes, specifically the user experiences and interfaces with games. In this session, the participants were also asked to introduce themselves by giving their name, current status (employment) and their thought on technology, specifically on games.

Questionnaire: Once the introductory session ended, the participants were asked to fill a questionnaire. The questionnaire developed is a modified version of the *Questionnaire for User Interaction Satisfaction (QUIS)*, developed by The University of Maryland Human-Computer Interaction Lab (n.d.). (Refer **Section 4.8.4**). The questionnaire consists of five sections that gather the participant's information, previous and current technology usage and game experiences, as well as the information on the game's interface feedback (also based on their experience). Participants were asked to fill Section 1 and Section 2 after the introductory session and Section 3 until Section 5 during the game play session.

Gameplay: The participants took part in playing three games (bowling, skiing and car racing) on two platforms; console and tablet. Each game session is monitored by the moderator. At the start of each session, a demonstration is conducted before the participants start the activity. Participants are also requested to fill in the questionnaire during the gameplay. This gameplay was conducted to gather participants' feedback, especially on their interaction and experience when playing digital games.

Group discussion: Group discussion or focus group interview was conducted after the gameplay sessions. The aim was to verify or remove irrelevant data observed during the gameplay. A semi-structured interview was conducted in this session. The open-ended questions were asked to obtain participants' opinions about their game experiences. Participants were allowed to talk freely and encouraged to interact with each other during the discussion. More specifically, the participants answered three main questions which are centred on their interaction and experience: (a) *what do they think about the games after playing it?* (b) *what do they feel during the gameplay?* and (c) *what do they gain by playing the games?* Additional questions were probed for in-depth insights, explanation and clarification.

The focus group ends with debriefing session by the researcher. Token of appreciation was given to all participants that took part in the study. All focus group sessions were recorded and transcribed.

4.6.5.2 Further Investigation Study

In *Further Investigation Study* was carried out to further investigate and validate the findings from the *Preliminary Study*. There were two tests conducted to validate the hypotheses: *1)*

Administer questionnaire and *2) Conduct focus group*. The online survey has been disseminated using two approaches for the duration of 3 months which was started on 20th November 2015 until 20th February 2016. Survey dissemination was conducted using two approaches; online survey and hardcopy (printed) questionnaire.

The Bristol Online Surveys (BOS), a survey tool that is licenced and approved by Coventry University was used to create the online survey for our study. This survey is continuity from the previous study (*Preliminary Study*) and will be part of the research hypotheses validation process. The survey has been improved and amended based on *Preliminary Study* outcomes by removing any biased to ensure considerations of more perspectives.

Respondents for the questionnaire were primarily approached via formal emails to various organisations (i.e. AgeUK, Coventry University, University of Bristol), forums (i.e. Older People Forum), online forums (The older gamers (TOG) http://www.theoldergamers.com/), groups (i.e. Research Volunteer Support Programme (RVSP), Facebook group (i.e. UK Older Gamers - The Group For Mature Video Gamers), existing participants, and also referral from colleagues, friends and other participants. Apart from that, several respondents were being approached face-to-face at the Coventry Market by the researcher. Refer **Appendix 7** for the list of participants approached.

Within the duration of three months, 100 respondents took part in this survey. Some respondents approached at the Coventry Market voluntarily signed-up for focus group session.

In the second test of the *Further Investigation Study*, five focus groups were carried out with a total of ten participants. Each group consists of between two and three participants. Group 1 (FG1) consists of three participants with two males and one female. Both Group 2 (FG2) and Group 3 (FG3) consists of one male and one female participants. However, Group 4 (FG4) consists of one female participant only due to the withdrawal of another participant at the last minute (personal reason). Refer **Section 6.3**.

Figure 4.13 *Further Investigation Study*: Focus Group Flowchart

Figure 4.13 shows the flow of the focus group session conducted during *Further Investigation Study*. It consists of three activities; 1) Ice-breaking and introduction, 2) game demonstration and game play and 3) group discussion. For each activity, the description was similar to *Preliminary Study* in **Section 4.6.5.1**.

4.7 Data Collection

This section highlights the types of data collection used in this research study to address the research questions and objectives. Data collection was carried out once the research problem and design were defined and identified.

There are two main data sources, categorised into two categories; 1) Primary and 2) Secondary.

4.7.1 Primary Data

Primary data is data collected using methods such as direct observation, questionnaires, interviews, and original documents. Malhotra and Birks (2006) addressed that primary data is originated by a researcher and designed for the specific purpose of addressing the problem.

Focus groups, group discussions, observation and questionnaire dissemination were conducted as the primary method for data collection. This applies to both of the study phases (*Preliminary Study and Further Investigation Study*). Data gathered from these methods were used to identify game design considerations and attributes and user's interaction and experience towards digital games. These data also used as a validation mechanism for our hypotheses. **Section 4.8** discusses these methods in detail.

4.7.2 Secondary Data

Data collected from television, radio, internet, journals, newspapers and research articles is called secondary data. According to Dawson (2002), secondary data can be expressed as a set of information which other researchers have already collected relating to the subject. Secondary data is data collected by someone else and passed through the statistical process (Kothari 2004).

The secondary data for this research was obtained through conducting a literature review. Onwuegbuzie *et al.* (2010) defined literature review as "an interpretation of a selection of published and/or unpublished documents available from various sources on a specific topic that optimally involves summarization, analysis, evaluation, and synthesis of the documents". According to Creswell (2012), a literature review is a written summary of journal articles, books, and other documents which consists of past and the current trend of certain research topic. This method is claimed to be the most important step of the research process in qualitative, quantitative and mixed research studies (Boote and Beile, 2005, Combs *et al.* 2010).

For this research, data and information reviewed were sourced from journal articles, conference papers, books, government documents, newspapers and online articles. Literature reviews (**Stage 1** in Figure 4.1) were conducted to analyse and synthesise knowledge and findings on relevant topics to research study (e.g. the challenge faced by older people and older people). Refer **Chapter 2, Section 2.2 and Section 2.6**. The analysis and synthesis of the literatures also fed into the other stages of the research in order to provide critical discussions of the overall findings and key knowledge contribution. Secondary data were mainly analysed during the early stage (**Stage 1** - refer Figure 4.1). However, secondary data were also sourced and analysed during other stages, where cross-referencing and further information were required.

4.8 Research Methods of Data Collection

This section discusses the data collection methods. The choices of methods used were determined by the type of data required for the study. Since this study is aimed to investigate older people's interaction and experience with digital games and views towards the issues, small (in Phase 1) and larger (Phase 2) scale of research surveys were designed for this study. The major instrument of data collection employed in this study was by a questionnaire, follow by gameplay and focus group discussion.

4.8.1 Collecting Primary Data through Focus Group Discussion

A focus group discussion is a process of collecting data through interviews with a group of people on a specific topic, typically four to six participants (Creswell 2012). Furthermore,

focus group discussion is also known as "conversation with a purpose" and is much less structured than any of research techniques for quantitative research (Ary *et al.* 2010). This method was utilised to collect shared understanding (i.e. feedback, suggestions) from the participants and to obtain their opinion on the interactions such as an interaction with the equipment (i.e. console and tablet) they performed with, social interaction and interpersonal interaction (refer **Chapter 5, Section 5.5**); and experiences while interacting with digital games.

Focus group was the qualitative approach of obtaining the data used in this study. It was selected due to several advantages it offered as data collection method. The advantages found by deploying this method were as follows:

i. Able to obtain information from the discussion topics (set by researcher or topic arise during the discussion and relevant to research study) and obtain the insights from the specific/individual participant. This information and data were obtained through interaction among the participants,
ii. During the focus group, active session and making sure all the participants to take part could stimulate each other's responses and through this, a new aspect appeared (i.e. participant shared their previous experience in playing games), and
iii. This method was also found to enable a proper observation and interaction among the participants and the researcher, which influenced the outcome of the discussions (i.e. one participant mentioned and showed how he could play car racing game (only by tilting) on the tablet although he has a hand tremor that could limit him to play the game).

4.8.2 Collecting Primary Data through Observation

Observation is information gathering process by observing the participants (without having an interview) and places (Kothari 2004, Creswell 2012, Awang 2012). Observation is the simplest form of data collection in a qualitative study (Ary *et al.* 2010) and has been selected as one of our primary data collection methods.

This method (observation) was applied concurrently within the focus group session (i.e. game play and group discussion) in both phases. It is used to determine how the participants interact during the gameplay and how they act during group discussion. During focus group

sessions, it was observed that the participants tend to hide their actual behaviour (during question and answer). Thus, the moderator will ask questions to all participants so that they all have the opportunity to answer and share their perspectives. Moreover, it was easy to understand better and get a clearer picture of what participants actually do and say, instead of just getting what people say they do, such as in an interview (Wærstad and Omholt 2013). Hence, with regards to this method, the advantage is to make a proper recommendation regarding the underlying phenomena in the study.

4.8.3 Collecting Primary Data through Recorded data

4.8.3.1 Audio Recording

By using this technique, a discussion during the focus group sessions was captured. The audio during gameplay and group discussion were recorded to ensure that a rich content of data could be considered in the analysis and that no feedback or comments made by the participants were missed.

After the focus group, the recorded data were transcribed verbatim. When transcribing the data, it is common to lose some visual clues, as well as the tone in the interview (Kothari 2004). Therefore, a camcorder was also used to capture and record the sessions.

4.8.3.2 Video Recording

Video recording was used as one of the methods for data collection in this study. It was employed to make sure that a clearer activities or participants' behaviour during the focus group sessions are captured. Hence, this method allows repeated examination of the data (images and sound) analysis (Bloor and Wood 2006) which then helped in discovering events that might have missed during the observation. In this study, the participants were asked to play digital games (COTS). Later, in the group discussion session they were asked to discuss and give feedback on their interaction and experience playing digital games. The gameplay sessions were video recorded. The observation was made on how the participants played and interacted with the games.

Data from both methods were viewed and analysed to obtain feedbacks on participants' interactions and experiences towards digital games. Data for representation quadrant was formed when analysing data using these approaches such as suitable game attributes and mechanics as well as game design considerations (i.e. how do they interact with console and mobile-based digital games?) for older people.

4.8.4 Collecting Primary Data through Questionnaire/Survey

Questionnaires/survey were developed and also used as a research instrument in the study which have been used in both phases; Phase 1: Preliminary Study and Phase 2: Further Investigation Study. Respondents were given different questionnaire for both phases (refer **Appendix 4** and **Appendix 6**) on a different set of date (refer **Section 4.6**). An advantage of using a questionnaire is that it allows the respondents to express their feelings, motivations, and experiences about the focus of the research (Gall, Borg and Gall, 1996). It also allows the respondents provide written responses to questions or mark items that indicate their responses (Ary *et al.* 2010). Considering this advantage, it seems that a questionnaire is appropriate in eliciting older people perceptions and views.

In Preliminary Study, the questionnaire was administered during the focus group session. Meanwhile, in Further Investigation Study, questionnaire or survey was disseminated online via Bristol Online Surveys (BOS), a survey tool that was used to create an online survey for this research study. A hardcopy of the survey was also disseminated in Further Investigation Study, where the respondents were approached face to face and this mainly took place at Coventry Market.

During Preliminary Study, the participants were required to fill the questionnaire in two separate sections (refer **Appendix 4**):

i. Ice breaking and introduction – to collect participations information (demographics background and technology usage), and
ii. During and after game play – to gain participants opinions, comments and suggestions on the game and the technology acceptance (platform utilised e.g. game console with Kinect and tablet).

The questionnaire developed is a modified version of the Questionnaire for User Interaction Satisfaction (QUIS), developed by The University of Maryland Human-Computer Interaction Lab (n.d.). QUIS was designed to evaluate users' subjective satisfaction with particular aspects of the human-computer interface. This questionnaire was referred due to its reliability and validity as well as the application of the questionnaire in several other research studies (Baudisch *et al*. 2002, Pisipunth *et al.* 2013).

In Further Investigation Study, the questionnaire questions were formed and derived from the findings found from Phase 1. Information obtained from both questionnaires consists of demographic background, technology usage, users' perceptions and views on their interaction and experience. This also includes the validation of research questions and hypotheses that correlate to the 4 quadrants. An example of the questionnaires used in this research study can be referred in **Appendix 6**.

This technique is chosen due to several advantages:

i. Data collected are relatively easy to analyse,
ii. Bias collection/assessment are reduced when uniform questions are presented,
iii. Time and cost effective, and
iv. Able to effectively gather data that can be analysed.

4.8.5 Collecting Secondary Data through Document Analysis

Based on Ary *et al.* (2010), content or document analysis is a research method applied to written or visual materials for the purpose of identifying specified characteristics of the material. Newspapers, books, web pages, television programmes, journals or any other types of documents can become an analysed material.

The secondary data were collected from several online materials, journals, research articles and newspapers that are related to our research study. The study of written materials can be fully utilised to aid in order to get a better understanding and enhancing existing information especially in the research background (literature review). This includes serious games framework, andragogy, and challenges associated to age-related of older people. All information from the documents (online, journals, research articles and newspapers) was then integrated with the primary data. Data produced from this integration were used to refine literature review as well as to define hypotheses from Phase 1.

4.9 Methodology of Results Analysis

In order to answer research questions, data collected need to be analysed. Some of the research hypotheses of this study have been tested using SPSS version 22 software. The data were examined to check whether it can be categorised as parametric or nonparametric data. Later, to analyse the data, the correct statistics procedure is identified.

Once all the intended data (qualitative and quantitative) have been collected, the analysis process begins. The results obtained from the analysis process is then reported and discussed. It is best to note that the analyses are addressing the research questions and the hypotheses.

Qualitative data were derived from participants' views with regard to their interactions and experiences interacting with the digital games. Quantitative data, however, were derived from administered questionnaire. Descriptive statistics were used in order to describe trends from the data, i.e. frequency of playing game. Then, an inferential analysis is conducted to compare groups or to create a relationship between two or more variables.

4.9.1 Questionnaire Analysis

Quantitative data analysis was performed using IBM SPSS Statistics 22.0. Descriptive statistics (frequencies and percentages) was used to examine demographics data and trends (frequencies of responses) in the data. The findings were also analysed using non-parametric tests of statistical significance; Kruskal-Wallis test and Spearman Rank Correlation (Spearman's rho), Mann-Whitney U Test, Chi-square were used where applicable to compare statistical results between participants or participants with other variables. These tests were used due to the small samples recruited and several data were measured on nominal (categorical, i.e. 'Yes ', 'No') and ordinal (ranked, 'Low', 'Medium', 'High') scales (Pallant 2013).

4.9.2 Focus Group Discussion Analysis

To transcribe the data, oTranscribe (http://otranscribe.com/) was used, which is a free web app for transcription. It is used to organise and analyse non-numerical or unstructured data. oTranscribe as a tool allows coding and transcribing of recorded data (audio and video).

Apart from that, Microsoft Excel 2010 and MAXQDA 12 were used to organise and analyse the qualitative data.

In relation to the qualitative analysis, all nine focus groups discussion (Study 1, n=4; Study 2, n=5) were transcribed. Content Analysis technique was used to analyse the participants' responses. Qualitative analysis shows how to examine theme, topics, symbol and similar phenomena while grounding the examination to the data. All data were collected and transcribed; all transcriptions has gone through the coding process. In this process, any relevant data with similar segments were highlighted and grouped into the same category. Besides noting the details and implications of data chunks, coding also allows easier data search process. It also eases the comparison process and identifying patterns for further investigation.

Once all the codes were collected into categories, they were then populated in a table in the order of the most to the least mentioned by the participants. Figure 4.5 shows the example of code represented in a table form. Refer Appendix 8.

No	Category (Keywords)	Code	No of People Making Comments (Frequency)
2	Ergonomic	1. Some are excellent the graphics are great on IOS 8 - P2F4 2. *I just like the best graphics possible – P2F4* 3. Anything that I said about that one. That particular tablet. That's quite heavy. .. Try to manipulate it on your wrist. It's quite a heavy tablet isn't it? Again, if you talk in older people who may well find their wrists are not that strong, it might be awkward to manipulate. Because it's quite heavy.- P1F3 4. *Yeah, it's heavy, yeah. – P3F3* 5. Tablet driving showed promise – I liked the use of tablets motion sensing for steering. – P1F4 6. *U want to know it always there and pause (remind??) it. And, if you accidentally press the... give me all the picture... buttons, nothing on the screen - no icon... u got to know how to get back and that is not always obvious. And the game is essential. Got to be auto reset (undo) what you just done. – P4F3* 7. I was pleasantly surprised by some features on the tablet (mainly the steering by tilting it – I hadn't thought of that as an option before the session), and the details visible were better than I would have thought beforehand. - *P1F4*	7
3	Social Interaction	1. Verity mentioned that she had played console game before at her brother house on Xmas day. Think it very funny to play with her family - playing tennis and hv a situation that is funny... ask other person to move a little bit – P1F3 2. *But I prefer to... but I don't mind playing with people like here (*means the focus group session*)... physically in the room. Even though both relatively stranger. Because of physically together in that.. it's fine. Because I can see them and we got the interaction. - P1F3* 3. It's fine. I enjoying penguin and cafe. – P4F3 (*playing game with his grandson) 4. *I supposed... I do like social interaction. But I don't use to have anybody else to play with. Now u see...*chuckle* - P2F4* 5. I'm more used to playing computer games as single user. I would think initially would be	5
		uneasy about not being able to start and finish as I wanted. Also the problem of matching performance. If one of us is performing significantly better or worse than the other(s), I would feel ill at ease I think. - *P1F4*	
4	Rules	1. Sometimes before playing the game, it wasn't always clear what we were meant to be looking at - P1F3, 2. *Raising hand to get the 'hand' is annoying as it didn't respond to me in real time - P2F3,* 3. I think it's absolutely crucial the right from the beginning you have the instructions that explaining exactly what you're doing and why? And you know, if you do something... this is what would happen... cause otherwise, you think... yeah, just lost! – P1F3 4. *Instruction (written or narrative) - I think in this be viable both ways because actually when you looking at screen, something in your ear telling what to do is good, for me. But then, I got quite good hearing. There are people don't hear very well. So they got to have it and on the screen. So it got to be both ways. But I think, having a clear screen and something in your ear would be very useful. - P4F3*	4

Figure 4.14 *Category*, *Code*, and *Frequency* of comments for interview with older people

4.10 Data Protection

Since the data collection involves the use of the online platform as the medium, data security and privacy should not be taken lightly. In normal practice, the platform should be closely scrutinised, especially when it involves participants' personal information. However, this is not an issue for this research study, where the study opted for Bristol online Survey (BOS) as the platform.

BOS is a survey tool that is licensed and recognised by Coventry University. It has proven to be a reliable and secure platform. It uses a secure connection and complies with Principle 8 of the Data Protection Act (http://www.legislation.gov.uk/ukpga/1998/29/contents).

4.11 Ethical Approval

Ethical approval was sought through the board of ethics committees at Coventry University before data collection began. Once the forum, group or organisations agreed to participate, they were provided with letters or emails describing the research. This letter or email was sent to invite participants.

Before recruiting participants, each of them will be given research information sheet and consent form. The information sheet will clearly outline the objectives of the research (refer **Appendix 2**). It also explains that the participation is completely voluntary and what to do if they wish to withdraw from the study. It also outlines information regarding confidentiality and how their data will be handled and stored. Apart from that, contact details of the primary researcher for any additional queries concerning the project's research are also made available. Participants are given a week to consider their participation before being asked to make a decision and sign the consent form.

The consent form with all its information and confidentiality agreements can be found in **Appendix 3**. This form was signed by all participants and by the researcher.

4.12 Summary

This chapter outlines the phases involved in the research development and the research design as guidance for research development. Mixed methods, a combination of both

quantitative and qualitative methods were chosen as powerful research methods used in data collection and analysis to answer the research questions and objectives.

A combination of various primary and secondary data was employed in this research study. Primary data was obtained from the focus group, questionnaire, interview and observation. Secondary data was from document analysis (literature review). The data obtained from above-mentioned methods were then descriptively analysed and validated. Then, these data are also used in validating the research hypotheses. Finally, the importance of data security and ethical approval were considered in this research, due to the nature of the research that requires interactions with people and organisations. The two next chapters will shows the results and analysis of the findings that is frame from this research methodology chapter.

CHAPTER 5

PRELIMINARY STUDY: RESULTS AND ANALYSIS

The findings of this research will be discussed into two parts namely, Phase 1: Preliminary Study and Phase II: Further Investigation and Validation. The Phase I findings will be illustrated in Chapter 5 whilst Chapter 6 will present the results and analysis of Phase II. This chapter is divided into three sections of which section 5.1 will provide an overview of the objectives and purposes of the intended findings gathered from User Interaction Survey (QUIS) and Focus Group. The Section 5.2 will elaborate data analysis gathered from the QUIS and focus group, that includes (i) Respondent profiling, (ii) Technological usage of respondents, (iii) Evaluation of on digital games by respondent and (iv) to identify correlation between previous findings of 4 Quadrants (‘*context’*, ‘*theory’*, ‘*user’* and ‘*representation’*). The section 5.3 will present summary of this chapter.

5.1 Overview of QUIS and Focus Group Session

This chapter is looking at four different key quadrants: *Context, Theory, User* and *Representation* (refer to **Chapter 3, Section 3.5** for the description and **Chapter 4, Section 4.1** for the research design). This process enables the research questions and hypotheses to be answered and validated. This chapter specifically focuses on *Preliminary Study* (Phase 1), Stage 2, where discussion on findings related to game design consideration and attributes are presented. Particularly, this Phase 1 will address the hypotheses using focus groups and highlight the findings related to user interactions and user experiences towards the digital games that would inform Phase 2. In Phase 1, different type of commercial games were utilised and participants were asked to participate in the gameplay. Participants’ perspectives were collected with regard to their interactions and experiences.

The findings discussed were based on data analysed from the same set of questionnaire disseminated to four groups (n=14) in Phase 1. The discussion is structured into four quadrants as mentioned earlier.

Four focus groups (n=14) were carried out. Table 5.1 shows total participants for each focus group and the recruitment location. **Chapter 4**, **Section 4.4** discusses the recruitment method

used by this study. The research was conducted through two methods. The main method is a set of questionnaires issued on the target audience. This questionnaire is referred as User Interaction Survey (QUIS). The second method is via focus group session performed on specific participants. The questionnaires was concentrated on (a) frequency of playing games (b) types of games preferred (c) the usability of technology used, whereas the focus groups session findings were recorded via data (audio and video) and are of discussion were *Demographics information and Technologies Usage.* The recruitment of this focus group was conducted via following avenues as per table below.

Table 5.1 Participant involvement and recruitment

No. of Focus Group	Total participants	Recruit from
Focus Group 1 (FG1)	4	RSVP group, ARC HLI-HLS
Focus Group 2 (FG2)	4	Cheylesmore Good Neighbours
Focus Group 3 (FG3)	4	HLS Group Volunteering, Coventry Healthy Walks, Coventry City Council Coventry University Staff
Focus Group 4 (FG4)	2	Coventry Healthy Walks, Coventry City Council

The research performed via both methods is intended to meet objectives and purposes as follows:

(i) to assess the technological usage of respondents;
(ii) to assess respondent perception on digital games; and
(iii) to identify the feedbacks and perceptions on any games interactions and experiences which are divided into the main four quadrants namely *'User*', '*Context',* '*Representation'* and *'Theory',*

The significant of the aforementioned findings will be discussed in details in Section 5.2 of which will also illustrate the target audience selected and participated for both methods.

5.2 Data Analysis

The data analysis of this chapter is aimed to understand the participants' perceptions of any digital games based on their age, context of the games, and reliability on games to respondents in terms of technological interphase as well as frequency of usage. Thus, the data analysis will be presented in following order:

i) User Quadrant: Characteristics and Technologies Usage
ii) Representation Quadrant: Respondent analysis of Focus Group
iii) Context Quadrant: Access the respondent perception on digital games
iv) Theory Quadrant: Relationship with the User, Representation and Context quadrants

The questionnaire was analysed using Microsoft Excel 2010 and IBM SPSS Statistics 22 to provide descriptive statistics and providing summarised insights on findings trend. Questions, personal characteristics and technologies usage were among the variables calculated for its frequencies. Cross-tabulations were also utilised to find relationships between variables such as characteristics (sex, gender, employment, skill in computer), technologies usage (platforms, hours played per day) and mode of play (single player, multiplayer).

Kruskal-Wallis, Spearman's rho, Mann–Whitney U tests and Chi-square were calculated for statistical significance. For this research study, significance different for criteria was set at p=0.05

5.3 User Quadrant: Demographics Characteristics and Technologies Usage

In Section 1 of the questionnaire, the general information about the participant such as *home postcode*, *gender*, *age group*, *employment status*, and *ethnicity* was asked. The frequency table, chart and figure in the next section provide results for the main participants' demographic information of the research project. Meanwhile, Section 2 of the questionnaire inquire the background of technologies usage by participants such as participant's computer skills, technologies used or owned, daily computer usages, the frequency of playing games and types of games played.

Table 5.2, 5.3 and 5.4 show the findings for the main characteristics of the participants. This study was aim for older people between the age of 55 and 75. Most of the participants were mainly between the aged 66-70 (see Table 5.3). Participants of 66-70 year-of-age (43% with

n=6, Male=3, Female=3) dominated this study (Phase 1) followed by 61-65 (29% with *n*=4, Male=1, Female=3), 55-60 (21% with *n*=3, Female=3, No male participant) and one participant from Over 75 age group (7% with *n*=1, Male=1, No female participant). There is no participant within 71-75 year-of-age took part in this study. Table 5.4 depicts the cross tabulation of participant's gender and their age group. The average age of participants was 65.04 (MEDIAN: 61-65). All participants were in the correct age bracket (above 55) for this study. A good mix of age groups in a correct bracket is necessary, especially when it comes to identifying game attributes and design considerations targeting older people. Almost all participants had a primary language of English with majority of the participants were British.

Table 5.2 Participant's Demographics including their *Postcode, Age Group, Gender* and *Ethnicity*

No of Participants	Participant N^0	Postcode	Age group	Gender	Employment Status	Ethnicity
1	**P1F1**	CV5	66 - 70	Female	Retired	White British
2	**P2F1**	CV7	55 - 60	Female	Unemployed	Asian other/ Asian mixed
3	**P3F1**	CV5	55 - 60	Female	Working Part-time	White other
4	**P4F1**	CV31	55 - 60	Female	Unemployed	White British
5	**P1F2**	CV3	66 - 70	Female	Working Part-time	White British
6	**P2F2**	CV3	61 - 65	Male	Retired	White British
7	**P3F2**	CV23	66 -70	Male	Working Part-time	White British
8	**P4F2**	CV3	Over 71	Male	Retired	White British
9	**P1F3**	CV4	61-65	Female	Retired	White British
10	**P2F3**	B60	61-65	Female	Working Part-time	White British
11	**P3F3**	CV7	66-70	Female	Retired	White British
12	**P4F3**	CV7	66-70	Male	Retired	White British
13	**P1F4**	CV2	61-65	Male	Retired	White British
14	**P2F4**	CV3	66-70	Female	Retired	White British

Table 5.3 Characteristics of Participants: *Age Category*, *Gender* and *Employment Status*

Characteristics	Category	Frequency	Percent (%)
Age	55-60	3	21.4
	61-65	4	28.6
	66-70	6	42.9
	Over 71	1	7.1
Sex	Male	5	35.7
	Female	9	64.3
Employment	Working Full-time	0	0
	Working Part-time	4	29
	Unemployed	2	14
	Retired	8	57

Table 5.4 Participant's gender vs. Age Group Cross tabulation

		Age Group				Total
		55-60	61-65	66-70	Over 71	
Gender	Male	0	1	3	1	5
	Female	3	3	3	0	9
Total		3	4	6	1	14

From the output shown in Table 5.3, the sample consists of five males (36%) and nine females (64%). Most of the participants were female. The main reason for this situation was because more female participants willing to take part in the study. Similar findings were found in previous studies (Pearce 2008; De Schutter 2011) where female players are more than male. Recently, statistics showed that almost half of gamers were female (ESA, 2013), and this revealed an increment of women players from all ages over the last decade. Additionally, most of the groups and organisations approached have more female than male

members. With regard to older people, women tend to outnumber men. Research by Kafai *et al.* (2008) reported that older women preferred to play casual games (i.e. Sudoku, crosswords) and their finding also found that women players outnumbered men players. This could be due to many accesses to digital games (especially casual games) through various types of devices such as PC, laptop, tablet, console and smartphone.

5.3.1 Social Grade

Analysing this particular question (specifically on the postcode), enables the analysis of the socioeconomic status of the participants. According to Danesh *et al.* (1999), Britain's individual postcodes are easily available and retrievable using existing commercial software. This can be used to estimate household income. It also can be used as a useful marker of social class.

The social grade defined by (Danesh *et al.* 1999) as the socioeconomic classification used by the Market Research and Marketing Industries to analyse the spending habits and consumer attitudes. It is also used widely by many organisations and companies for market research. The social grade classification (see Table 5.5) divided into six categories that are based on the occupation of the head of the household (Danesh *et al.* 1999):

Table 5.5 Social Grade Classification

A - Upper Middle-Class	Higher administrative, managerial or professional
B - Middle-Class	Intermediate managerial, administrative or professional
C1 - Lower Middle-Class	Supervisory or clerical and junior management, administrative or professional
C2 - Skilled Working Class	Skilled manual workers
D - Working Class	Semi and unskilled manual workers
E - Non-Working	Casual or lowest grade workers, pensioners, and others who may rely on the welfare state for their income, including students.

For this research project, PostcodeArea website (http://www.postcodearea.co.uk/) was used to retrieve the participants' social grade classification for analysis purposes. The demographic statistics referred from this website was taken from the 2011 Census (ONS 2014). The data

provided were extracted from the Office of National Statistics (ONS) (ONS 2014), the organisation that responsible for the collection and publication of UK statistics relating to population, society and economy. Figure 5.1 shows an example of the percentage of social grades classification in the postcode area of CV31.

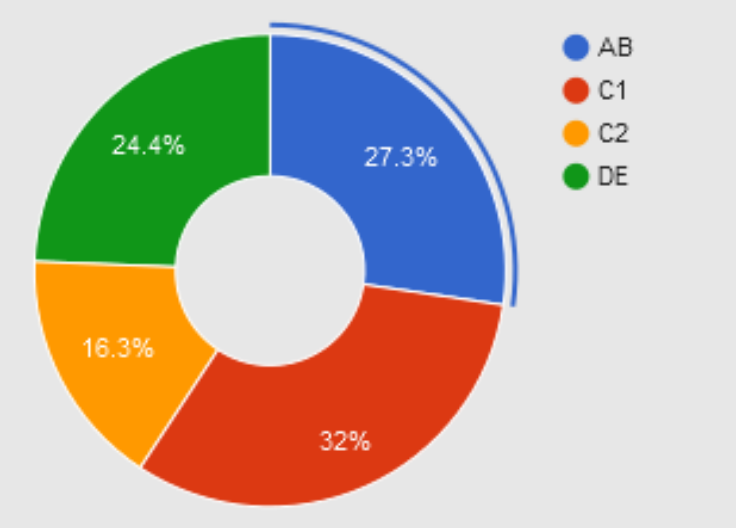


Figure 5.1 Social Grade of CV31 postcode area (Postcode Area 2014)

Relevant findings from this show that most of the postcode area has the highest participants from C1 category compare to other categories. This social grade shows the economic background of the participants and can be in line with the technology usage and ownership that is found in this study. All participants reported that they own personal computer. This technology stated used in daily basis for any email activities, reading purposes (news, weather forecast, traffic information services) and word processing. Besides that, two popular mobile devices found used and owned by the participants were normal mobile phone and smartphone. Similar to previous studies on computer usage Kinsella and Velkoff (2001), it shows increment of computer users among older people aged 50 and above. There were 57% participants were retired and 29% were still working part-time and only 14% did not work (Table 5.3). It is proven the studies by Kooij *et al.* (2008) reported that people over 50 are the growing group of the workforce and they using computer to perform their daily tasks.

5.4 Context Quadrant: Assessment of Technological Use

Table 5.6 Participant's Background on their Technologies Usage

Technologies Usage	Frequency	Percentage (%)
Computer Skills		
Expert (can perform various tasks on computer)	4	28.6
Competent (confident to use various software such as processor, web surfing, email)	10	71.4
Novice (can perform limited tasks, i.e. web surfing, email)	0	0
None (never used)	0	0
Computer Usage in Daily Activities		
Every day	12	86
Several times a week	2	14
Once a week to once a month	0	0
Never used	0	0
Play Digital Games		
Every day	5	36
Several times a week	0	0
Once a week	0	0
A couple of times a month	2	14
Less than once a month	2	14
Do not play	5	36
Favourite Aspect of Games		
Discovering new features or levels in the game	5	
Playing with other people/socialising	6	
Competing, winning, beating opponents	9	
Completing challenges or quests	5	

Table 5.6 summarises participant's skill in using computer and their patterns of use in playing digital games and computers. More than half of the participants (10 out of 14, 71%) categorised themselves as competent in using computer and four participants (29%) categorised as expert. This finding found that the older people computer literacy is very good and oppose to the common stereotype assuming the older people were afraid and not

competent enough when handling technology, computer in particular. In regards to their frequency in using computer and playing digital game, 86% of participants stated using computer 'Every day' and only 36% of participants indicated they play digital game 'Every day' which is similar percentage to those who were not playing. Following section will discuss more on this finding.

5.4.1 Age Category and Frequency of Play

The participants were assessed upon frequency of using or playing digital games. The finding of analysis is tabulated as below table.

Table 5.7 Cross-tabulation of sample data showing participant age and gameplay frequency

What is your age range?	**How often do you play games?**						**Total**	**Percentage (%)**
	Every day	Several times a week	Once a week	A couple times a month	Less than once a month	I do not play any games (computer or digital games)		
55 - 60	0	0	0	1	1	1	**3**	**21**
61 - 65	2	0	0	0	1	1	**4**	**29**
66 - 70	2	0	0	1	0	3	**6**	**43**
71 - 75	0	0	0	0	0	0	**0**	**0**
Over 75	1	0	0	0	0	0	**1**	**7**
Grand Total	5	0	0	2	2	5	**14**	**100.0**

The findings as in Table 5.7 shown a support research of (Lenhart *et al.* 2008, ESA 2016) that currently, the trend shows that there is an increasing number of players are from specific age categories particularly from 55-70 (55-60: 21%; 61-65: 29%; 66-70: 43%). Whereas the percentage frequency by distribution of participants' age, Table 5.7 shown that the participants who were in the age range of 61-65 and 66-70 are the groups that played digital games on daily basis. In regards to their employment status, most of the participants within this age range were retirees (refer Table 5.3). Having more leisure time to play was the reason of this trend which is similar to the finding by (Lenhart *et al.* 2008).

Table 5.8 and Table 5.9 show the percentage frequency distribution of participant's age and gameplay, respectively. It shows that both '*Everyday*' and '*I do not play any games (computer and digital game)'* items have equal percentages of 35.7%. Similar situation with playing *'A couple of times a month'* and *'Less than once a month'* which have equal percentages of gameplay frequency of 14.3%. 50.0% of participants in the age range of 61-65 played games every day, which is contradicting to 50.0% of participants do not play any games (computer or digital games) from the age range of 66-70. Only one participant (Over 75) took part in this study, and stated he played game '*Everyday'*. Meanwhile, a balanced percentage of 33.3% of gameplay frequency by age group of 55-60 were observed from*, 'A couple of times a month', 'Less than once a month'* and '*I do not play any games (computer and digital game)'*.

Table 5.8 Percentage frequency distribution of participant age

	GAME PLAY FREQUENCY				
Age Group	Every day	A couple of times a month	Less than once a month	I do not play any games (computer or digital games)	Grand Total
55 - 60	0.0%	33.3%	33.3%	33.3%	100.0%
61 - 65	50.0%	0.0%	25.0%	25.0%	100.0%
66 - 70	33.3%	16.7%	0.0%	50.0%	100.0%
Over 75	100.0%	0.0%	0.0%	0.0%	100.0%
Grand Total	**35.7%**	**14.3%**	**14.3%**	**35.7%**	**100.0%**

Table 5.9 Percentage frequency distribution of game play frequency

	GAMEPLAY FREQUENCY				
Age Group	Every day	A couple of times a month	Less than once a month	I do not play any games (computer or digital games)	Grand Total
55 - 60	0.0%	50.0%	50.0%	20.0%	21.4%
61 - 65	40.0%	0.0%	50.0%	20.0%	28.6%
66 - 70	40.0%	50.0%	0.0%	60.0%	42.9%
Over 75	20.0%	0.0%	0.0%	0.0%	7.1%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

This finding shows the positive acceptance towards the digital games among older people, where participants revealed that they play games every day, with a minimum of less than once a month. This finding also in line with the finding by ESA (1999) and reject the stereotype regarding the older people were afraid of technology and did not play digital games. Most of the participants who took part in the study asserted that they were willing to continue to play if they can see a clear benefit it can bring to them. **Section 5.5.2** discusses the participants' feedback thoroughly.

5.4.2 Gaming Status

Additionally, from the above analysis, the participants are labelled as 'non-gamer' or 'gamer'. As from the survey, nine out of fourteen (64%) participants were classified as non-gamer. This includes those who played games occasionally or not at all. Only five (36%) participants were considered gamer, who played games every day (61-65 (40%), 66-70 (60%)). Figure 5.2 illustrated the percentage of participants' classification, either a gamer or non-gamer.

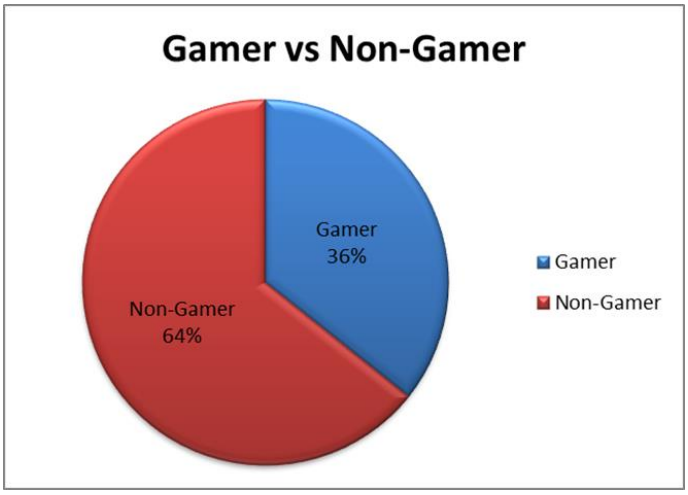


Figure 5.2 Gamer vs. Non-Gamer

This finding shows that majority of the participants in this study were classified as the non-gamer. Although this study shows only 36% of participants were gamers, work by (ESA 2011) reported that the percentage of older people embracing and playing the digital games via console or any computer device is increasing year-by-year since 1999. Under this

reasoning, it is worthwhile to conduct this study. Lack of participants participating in this study is one of the reasons for such finding.

Besides that, the cost of game platforms such as game console (i.e. Xbox, PlayStation and Wii) and participants' perception of gameplay (i.e. *not suitable for older people, no learning outcome*) were also among the reasons that have driven this particular trend. Thus, further study is needed to gain concrete results of this particular finding (discussed further in Phase 2: *Further Investigation Study*).

5.4.3 Player Type

Question 10 in Section 2 (refer **Appendix 4**) was analysed to assess whether a player type has an impact on the preference for different game mechanics/attributes. This study considers the player personality types. It should have an impact on how they can be motivated to play, learn and stay engaged because "*different people enjoy different types of fun*". Several aspects of an electronic game that participants enjoy the most have been pre-correlated with a Bartle's player type (Bartle 1996) and Social Action Matrix (Kim 2014). Table 5.10 shows the player type corresponds to answer from Question 10 in Section 2.

Table 5.10 Player Types

Bartle's Player Type	Social Action Matrix	Aspect of Game Play
Achiever	Creator	Completing challenges or quests
Killer	Competitor	Competing, winning, beating opponents
Explorer	Explorer	Discovering new features or levels in the game
Socialiser	Collaborator	Playing with other people/socialising

Based on Zichermann and Cunningham (2011), the majority of players tend to be a socialiser or playing a game together with others. Surprisingly from the finding, not all participants preferred to play with other people (socialiser). Eight participants mentioned that they did not prefer or never want to play games with other people. This finding show may give contradictions to Zicherman and Cunnighman as the participants may played for specific reasons rather than socialisation aspect that digital games can offer.

5.5 Representation Quadrant: Assessments of User's Perceptions

5.5.1 Games Attribution

Further to analysis from Question 10, the questionnaire was also focused to understand aims of participants playing digital games. Therefore, the Bartle's player type was paired with serial pleasurable variables of games mechanics to examine whether the relationships between Social Action Matrix and the specific game mechanics can be identified.

This analysis is cross related to Questions 4 in Section 4 (refer **Appendix 4**) where the respondents were asked to identified which of the following game mechanics/attributes that attracted them to play digital games, namely:

(i) mastery;
(ii) immersion,
(iii) winning,
(iv) narrative,
(v) integrated theme,
(vi) tactical play,
(vii) shared fun,
(viii) competition,
(ix) cooperation,
(x) intellectual challenge,
(xi) learning new games,
(xii) social interaction,
(xiii) attractive components,
(xiv) strategic play,
(xv) in-game interaction

Hence, based on Table 5.11, the findings shows that the *Achievers/Creators* has the highest preference for mastery, tactical play, strategic play and intellectual challenge as they like to accomplish things, and these mechanics indicate progress and task completion. *Killers/Competitors* were more interested in competition and beating opponents (i.e. computer, human). Thus, the best-correlated mechanics were winning and competition. Meanwhile, *Explorers* enjoy exploring the game environment and game features. Their preference will be on immersion, narrative, integrated theme, learning new games and attractive components. *Socialisers/Collaborators* that enjoyed socialising in gameplay will have a high preference towards shared fun, cooperation, social.

Table 5.11 Player Types and Game Mechanics

Player Type	Game Mechanics
Achievers/Creators	Mastery, tactical play, strategic play, intellectual challenge
Killers/Competitors	Competition, beating opponents
Explorers	Immersion, narrative, integrated theme, learning new games, attractive components
Socialisers/Collaborators	Shared fun, cooperation, social interaction, in-game interaction

In addition, with reference to findings of the Question 4 as per Figure 5.3 below, this bring a significant understanding that nine out of fourteen participants believed that intellectual challenge aspect brings pleasure while playing games. The reasons why they preferred this particular aspect are; 1) to relax and fulfil their leisure time with beneficial activities and; 2) play games that can challenge them especially to think, which can lead to brain stimulating. However, participants do not prefer games that were too difficult or too easy because it will make them frustrated and disengaged from continuing to play.

Whereas five participants were open to the idea of trying out new games which they found it as 'fun to try something new'. Each of these game aspects - *competition*, *winning* and *mastery* also have been selected by these five participants. The participants stated that they like to compete while playing games. However, they prefer to compete with their friends or family members and sometimes with the computer itself. In fact, they do not like to play with other people especially with people they do not know or stranger. It shows that the older people tend to become an achiever/creator player rather than a socialiser player as posited by Zichermann and Cunningham (2011).

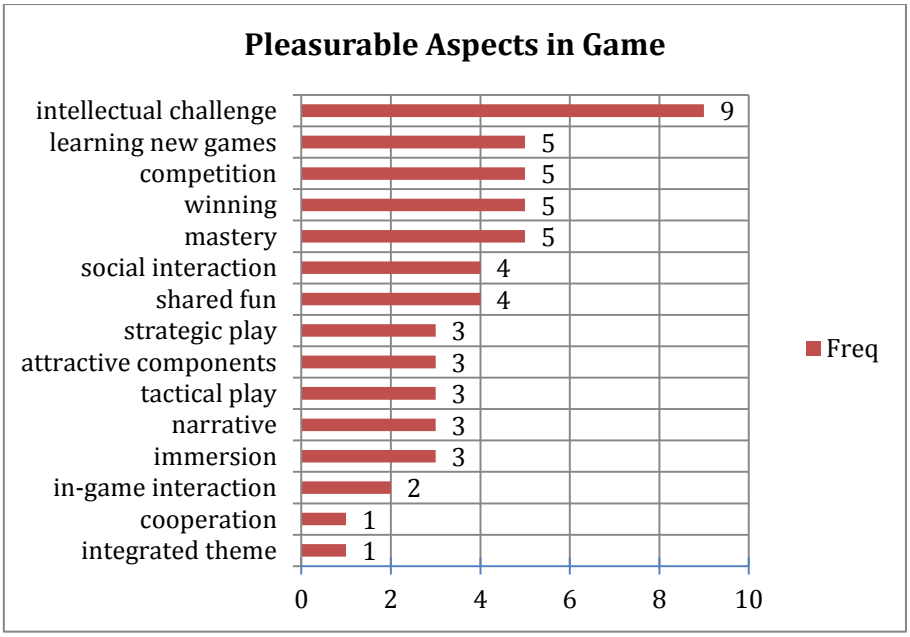


Figure 5.3 Gameplay aspects versus Frequency of Feeling towards gameplay aspects

A similar result obtained from focus group discussion since four of the respondents indicated that it is for social interaction and shared fun. For example, one participant mentioned that she played console games (Wii) on Christmas day with her family members. These four participants do not mind having a companion while playing games and enjoyed the idea of socialising which could allowed them to interact actively with others during the game play it as two of the participants quote:

Id	Quote
P1F3	*'I had played console game before at my brother house on Christmas day. I think it's very funny to play with my family… playing tennis and we have a situation that is funny... ask another person to move a little bit' *Chuckles**
P2F1	*'I only play if I have time to spare or because of playing with friends/family'*

Meanwhile, the participants also had responded other reasons as in Table 5.12 on the factors they played digital games.

Table 5.12 Responses of from focus group participants

Id	Quote
P1F1	*Because I can play when I want to*
P4F1	*Use it to relax and not competition*
P3F2	*So, I can concentrate*
P1F4	*Easier to 'schedule'*
P2F3	*Not need to playing games with others*

Table 5.13 illustrates focus group responses in details on the factors they played digital games. Hence this finding brings to conclusion that besides for having social interactions with others, digital games are chosen for providing the respondent intellectual challenge and to learn new games. This finding is similar to Nap *et al.* (2015) that indicate digital games as a memory training tool and learning game purposely-built for older people.

Table 5.13 Pleasurable game aspects

Participant N^0	Most pleasurable game aspects
P1F1	Competition, Attractive components, Intellectual challenge
P2F1	Learning new games, Narrative, Strategic Play, Intellectual Challenge
P3F1	Immersion
P4F1	Learning new games, Narrative, Cooperation, Intellectual Challenge
P1F2	-
P2F2	Tactical Play, Learning New Games, Social Interaction, Winning, Competition
P3F2	Mastery, Strategic Play, Intellectual Challenge
P4F2	Mastery, Immersion, Winning
P1F3	Mastery, Shared Fun, Social Interaction, Competition, Intellectual Challenge
P2F3	Winning, Competition
P3F3	Mastery, Shared Fun, Social Interaction, Winning, Competition, Intellectual Challenge
P4F3	Tactical Play, Shared Fun, *Social Interaction, Strategic Play, Intellectual Challenge
P1F4	Mastery, Tactical play, Learning New Games, Winning, Attractive Components, Intellectual Challenge, In-game Interaction
P2F4	Learning New Games, Immersion, Shared Fun, Social Interaction, Attractive Components, Narrative, Integrated Theme, Intellectual Challenge, In-Game Interaction

5.5.2 User Evaluation of the Digital Games on Console and Mobile Platforms

Two platforms selected as the research instruments, which were console games and mobile games. For the console platforms, Xbox 360 Kinect was used for gauge respondent view on games that have gesture-based and physical interactions. The selected games of Xbox were *Kinect Sport: Bowling*, *Kinect Sport-Season Two: Skiing* (On Xbox 360 with Kinect) and *Bowling* (see Figure 4.2). For Android platform, *Traffic Racer* was selected to investigate respondent views on touch-based interactions platforms (see Figure 4.4).

These games were selected as to evaluate if platforms that offer 'natural user interface' would be the participants' preference as (Tanaka *et al.* 2002) purported it is important that the participants were analysed on their intuitiveness of a natural user interface since it can ease the interaction between the participants and the technology.

5.5.3 The preferred Digital Games

The participants were asked to evaluate the digital games that are selected as research instruments and their feedbacks are segregated into the following subsections (a) Response on Kinect Sports and Kinect Sports: Season Two (b) Response on Bowling and (c) Response on Traffic Racer. These assessments aimed to examine if games of console platforms (i.e. Xbox, PlayStation and Wii) and the participants' perception that i.e. *not suitable for older people, no learning outcome*. Hence, hypothesis of such perceptions is discussed in Phase 2: *Further Investigation Study*, under Chapter 6.

(a) Response on Gesture-based interaction

Bowling and *Skiing* games were the two chosen games from the "Kinect Sports" and "Kinect Sports: Season Two". There were twelve others sport within these two commercial games. These games stimulate movement and activity in a fun and challenging way. These games also offer both cooperative and competitive plays and can be played in two modes; either single player or multi-player. These games were chosen because of its ability to entice excitement and also imitates real movement in a particular sport which indirectly leading to

some form of exercising. Besides that, these games encourage and promote active interaction between players. Figure 4.2 shows the two chosen games.

The data obtained from these games were the participants' feedback especially on player's interaction and experience. It consists of participants' feedbacks on gameplay using console platform which most of the participants attracted to the physical movement that is gesture-based interaction it offered. Participants also pointed out they could relate those games with real life experience. In addition, console offers natural user interfaces and intuitive that can ease the interaction between the participant and technologies in a natural way (Tanaka *et al.* 2012). In terms of the aesthetic aspects, older people highlighted they do not have any problem during the gameplay using console. The displays (screen size, font size, icon/button), the navigation and interaction, and also the multimedia outputs (graphics quality, audio) reported as at appropriate level to them. However, they have addressed that they need to learn some technical skills prior to playing the actual game.

(b) Response on Touch-based interaction

Bowling game on tablet-based technology device was selected to obtain feedback from the participants to distinguish the differences of interaction and experience by using different platforms. This will be the comparison benchmark for the participants to evaluate and explain their experience for this type of digital games (sport/exercise). This game also has the challenge (competition) function where it can be played in two modes; either single player (against computer) or multi-player (against other players). Similar to previous mentioned games, it also encourages and promotes active interaction between players.

Similar to previous games, the data obtained from this game is the participants' feedback especially on player's interaction and experience. Participants' feedbacks on gameplay using tablet platform which highlighted on the touch-based interaction (slide smoothly on the screen or press the icons to choose option) and aesthetic aspects such as the design (screen size, font size), graphics quality (resolution, contrast) and audio output (sound, volume).

Another game that was played on tablet-based platform was a racing car game, *Traffic Racer* (Figure 4.4). It is a single-player game and presented in an interactive 2D graphical user interface and offered an unprecedented level of driving enjoyment. It is an endless driving game with different game modes. This game was chosen due to its ability to facilitate

enjoyable experience and it is fun to play. It has the challenge (competition) function and also offers new skill (i.e. tilt) to the participants by imitating real driving environment (i.e. steering the wheel). It is a straightforward game and offers a friendly approach that could create an enjoyable time for players.

The data obtained from this game is the participants' feedback especially on player's interaction and experience. It consists of participants' feedbacks on gameplay using tablet platform (slide smoothly on the screen or press the icons to choose option) and aesthetic aspects such as the design (screen size, font size), graphics quality (resolution, contrast) and audio output (sound, volume).

5.5.4 User Evaluation of the Games Specs

(a) Screen

With regard to the screen size, the study conducted confirms that older people prefer to look at a larger screen rather than relatively smaller ones. The comparison here was based on what they have seen and experienced during the gameplay activity using both console-based and tablet-based devices. However, the main criteria that this study investigates were the participants' feedback towards the colour contrast, appropriate text size and better quality images/graphics. These criteria were used, as it is directly correlated to the health decline associated with ageing.

(b) Icon/Button

Figure 5.6 shows the finding with regards to the icon/button feature for the studied games during the gameplay session. The X-axis refer to the categorisation, with regards to easiness towards the visibility and navigation of the icon/button itself. According to Fezzani *et al.* (2010), older people prefer to look at large targets (e.g. button, icon) which could contribute to larger input and output (e.g. screen size, font size). A similar finding was observed in this study which shows that all participants preferred icon/button that easily to be seen and at an appropriate size for them. This will indirectly bring benefit to older people with vision problems. It also shows that participants prefer to have icon/button that can support pointing

accuracy and does not require much strength to navigate. Five participants did not answer this particular question; four participants did not provide feedback for console while one participant did not answer this question at all. However, these participants provided feedback verbally during the focus group and confirm the similar finding.

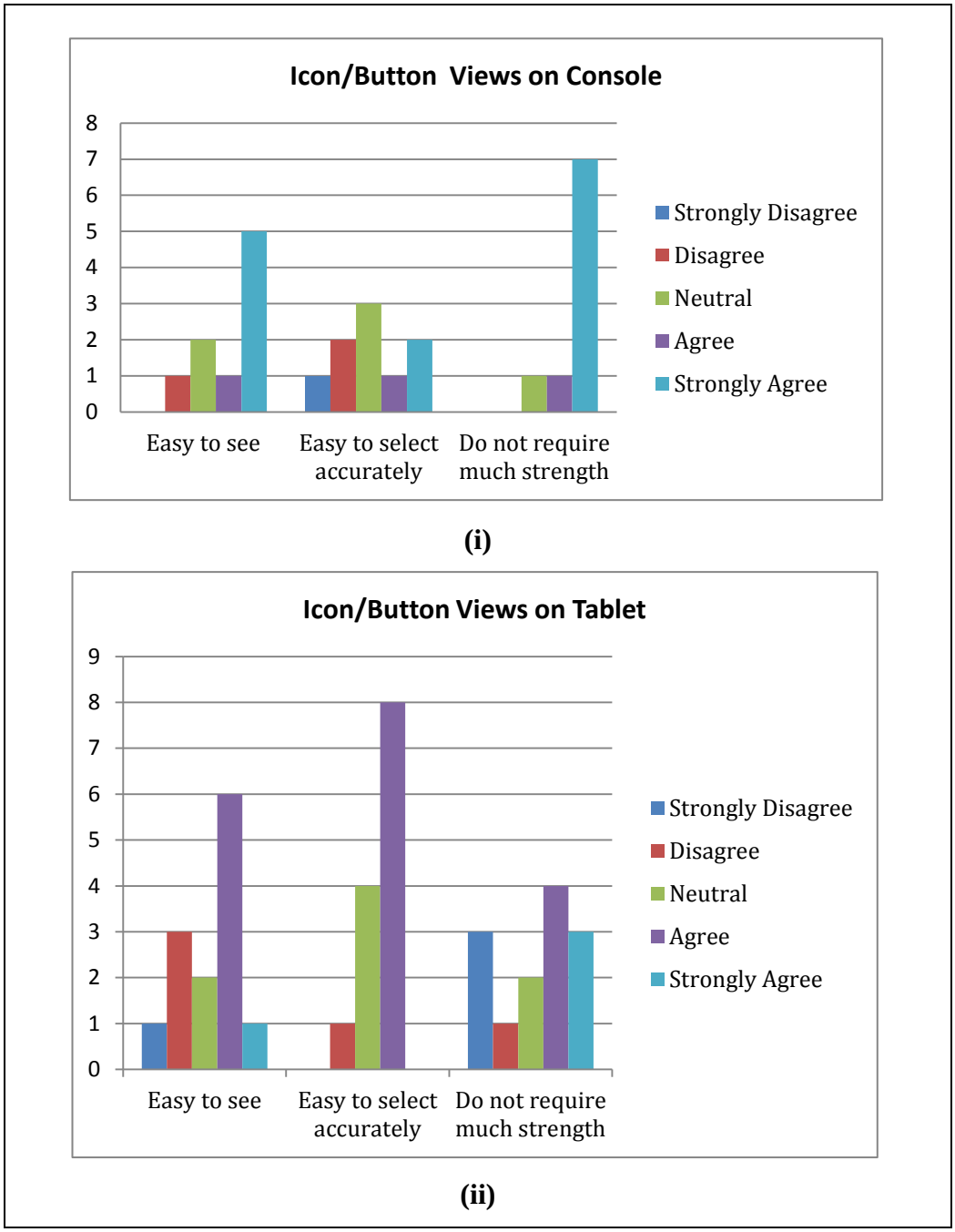


Figure 5.4 Easiness towards the visibility and navigation of the Icon/Button: (i) *Console* and (ii) *Tablet*

(c) Navigation

The navigation aspects of both platforms were divided into two categories; Navigational ease and Navigational structures (sequence of screens). For the tablet platform, participants mentioned that it was easy to navigate using a tablet. Feedbacks obtained from the participants are shown in Table 5.14.

Table 5.14 Responses on Navigation aspects on Tablet

Id	Quote
P1F4	*Navigation to application and through setup worked well*
P2F1	*It is easy. Straightforward*
P2F2	*Tablet more sensitive to actions*

With regards to console-based, there were three participants stated that the console requires time to learn for starting/setting up and navigate before even begin to play the games. Also, they found that console is 'not significantly intuitive and too many terms to be learned' and they would prefer navigation that is smoother, sharper and more accurate. There were no feedbacks from the rest of participants.

On the navigational structures, all participants verbally reported that they did not have any significant problems while navigating through the screen since it is always in a proper sequence.

(d) Interaction

There were two questions asked regarding the interaction aspects of the tablet which are *Gesture of interaction* and *Message (feedbacks) appear on the screen*. Twelve participants satisfied with the interaction aspects of the tablet. They mentioned that they did not have any issue when interacting with the tablet platform. However, three participants did found some issues (i.e. heavy tablet, uneasy to control and unclear feedback) while playing games in the tablet-based platform. The participants' responses are shown as in Table 5.15.

Table 5.15 Responses on Interaction Issues on Tablet

Id	Quote
P1F3	*All finger swipes or physically moving the tablet. The tablet itself is quite heavy*
P1F4	*On bowling selection of bowling ball and control was not easy and feedback not very clear*
P2F4	*Not fast enough*

With regards to console platform, five participants gave feedbacks on the interaction aspects issues (i.e. require technical 'know-how' skill, respond not fast enough, unclear feedbacks) that they experienced while interacting with the console. The feedbacks are shown in Table 5.16.

Table 5.16 Responses on Interaction Issues on Console

Id	Quote
P1F3	*OK once I knew what to expect*
P1F4	*Sometimes the interaction was awkward, didn't always allow movement I was expecting to achieve*
P2F3	*Not in real time. Is it working?*
P2F4	*The message could be in darker bolder text. Gestures need to be more accurate to the person movements*
P4F3	*Skiing game (fast game) - feedbacks useless and annoying because game too fast to use them*

(e) Learning the System

All participants indicated that learning to use the tablet (e.g. learning basic operation, getting started and learning advanced features) was very easy and straight forward. Participants also agreed that all tasks were easy to perform with clear feedback upon every tasks completion.

Meanwhile, participants asserted that it would require technical skill ('know-how') and easier to understand if have some degree of computer literacy when dealing with the game console.

However, this is not relevant for this study. All the prior set-up and navigational task were conducted before the participants start to play.

(f) Interface Capabilities

Two characteristics of interface capabilities of tablet and console have been asked, which were *Ease of operation depends on your level of experience* and *Correcting your mistakes.* Participants rated that it was easy to correct their mistake during gameplay on a tablet but otherwise on the console. Two participants stated that it was not easy to play the game using the console and needed assistance to perform it. On the contrary, this happens for a short while before they managed to perform the gameplay on their own. To create interface capabilities aiming for older people, one participant, P1F1, suggested that the game should provide big and bold texts; including audio instructions with no time limit.

(g) Multimedia

In multimedia questions, three characteristics were evaluated, namely *sound output, adjustable audio output* and *colours used.* These characteristics were evaluated for both platforms. Feedbacks from participants mentioning that sound instructions must be included and must be audible and adjustable, to support older people with hearing problems. Responses by participant:

'Sound instructions needed… I won't get lost' (P1F1)

Figure 5.7 shows 60% of participants rated the sound output as audible with 20% each for moderate and inaudible. On top of that, 50% participants agreed that both platforms audio was adjustable (refer Figure 5.8). However, several participants' feedbacks mentioned otherwise. This variation of feedback was due to the background noise during the focus group sessions. As earlier mentioned, the focus group sessions were conducted at various location, based on the travelling distance and the convenience of the participants. Some of the venues were a bit noisier than others thus this variation of feedback was obtained.

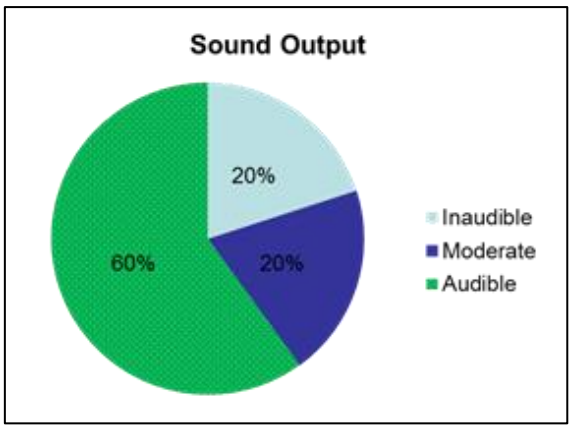


Figure 5.5 Sound Output

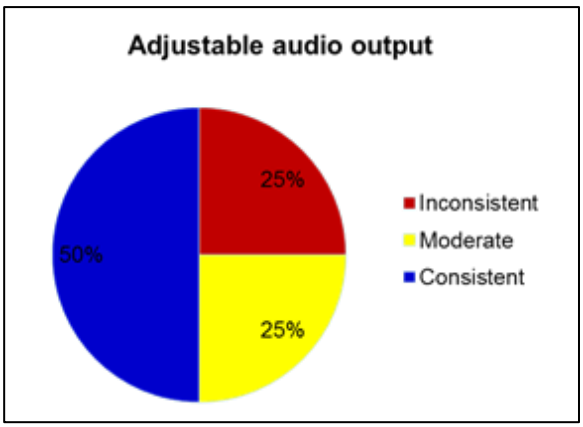


Figure 5.6 Adjustable Audio Output

With regards to colours used in the games, 60% of participants agreed that the colour used were appropriate for older people (refer Figure 5.9). One participant, P2F4, mentioned the colours used were not perfect but '*as long as it shows a hint of brightness it is good fun and stimulating'* to her.

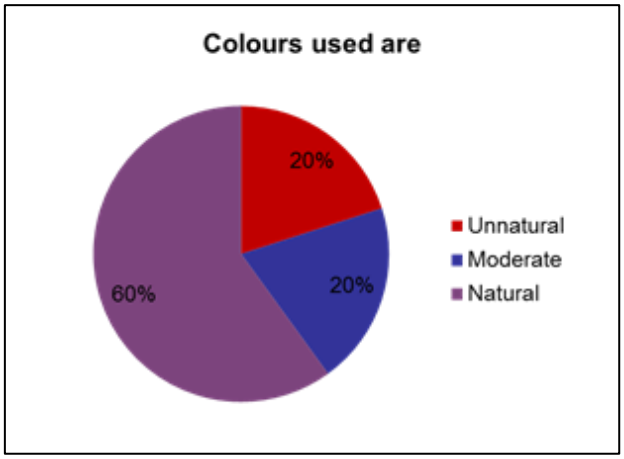


Figure 5.7 Colours Used

From the findings, it shows that sound and colours (graphics) were among the key features that must be considered in investigating the older people's interaction and experience while playing games. Participants asserted that sound instructions should be included and must be audible and adjustable. This is important to support older people with hearing problems.

According to Ijsselsteijn *et al.* (2007), distortion makes it hard to older people to understand synthetic speech. They mentioned that for non-speech audio signals, lower frequency tones (in the 500-1000 Hz range) are easier for older people to hear than higher pitched sounds. It is

advisable to provide redundant information (multiple modalities – vibration or light); and parallel visual and auditory presentations (e.g. speech recognition) (Fisk et al. 2009).

With regards to colours, (Caprani *et al.* 2012) recommended using high colour contrast for older people or colour blind users. On top of that, Zhao (2001) suggested maximising contrast by using dark types on light or white backgrounds or vice versa.

5.5.5 Overview on User's Interaction and Experience

5.5.5.1 Platform

Based on Question 1 in Section 4, there was a balanced number of participants (*n*=7 each) choosing either platform; console and tablet. Refer Figure 5.10.

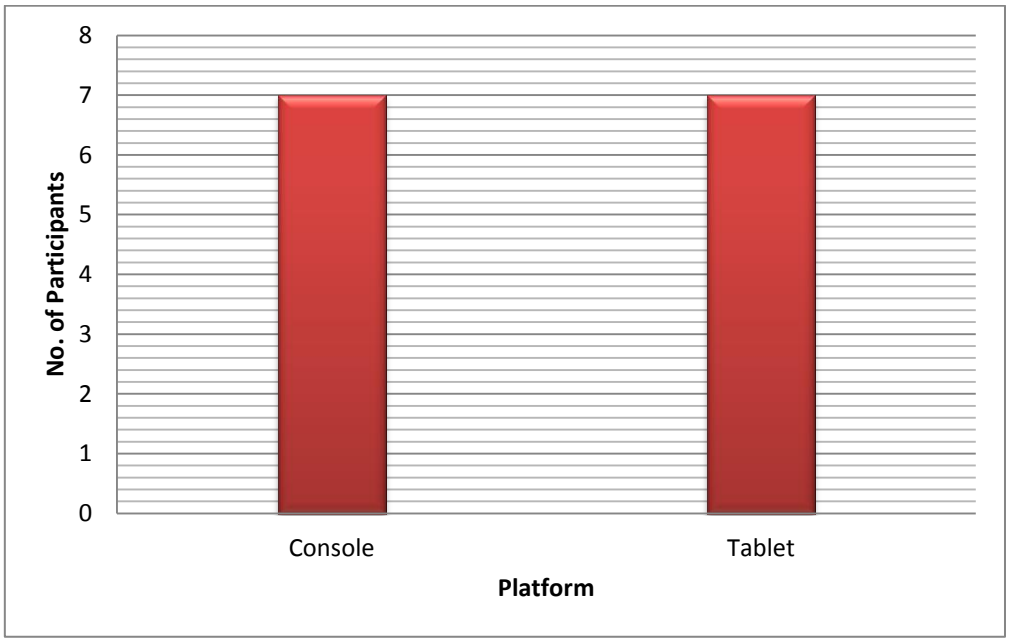


Figure 5.10 Console versus Tablet

According to the participants, both platforms have their advantages and disadvantages. Thus, this contributes to the selection of platform by the participants – on which they favour the most. Responses from participants on both platforms listed in Table 5.17.

Table 5.17 Advantages of Console and Tablet Platforms

Console	Tablet
More comprehensive displays	*Can play individually/alone*
Big screen easy to see	*More portable*
There is physical element	*Easier to play*
More fun and more physical	*Can be used when seated/lying down/resting*
Better graphics, enabled better control	

Half of the participants prefer to play games on a tablet, with the main reasons being that they can play alone (i.e. when they want to), its portability (can play anywhere at any time) and easy to use and play (less setup process). This has been pointed out by one participant, P4F1,

"I prefer using a tablet. If you've got pain or disabilities, much easier to use a tablet. You don't have to be home to do that. It's much portable. You can do it on a train or bus, or sitting and waiting".

Another participant, P1F4, indicated that the size factor would influence people to select the tablet-based platform over the console-based platform.

"That's convenience that can be it, because of the size. Can put it in, carry it in a bag and probably isn't that too long. If some see shape likes that and it's about the size of the book".

The other half of the participants stated that they found that the console platform has a comprehensive display (better graphics, big screen), which enabled better control, a better interactivity (which makes it more fun to play) and provided immersion (i.e. flow), as well as offer physical movement. One participant, P3F1, stated,

"I like to play on that Xbox because you can immerse yourself in the game. And it's not dangerous and you don't need special equipment… You're in the flow and you're doing exercise while doing it. It's easy to understand what you're doing".

Despite the advantages of both platforms, several disadvantages were also highlighted. For console, the downfall due to the cost barrier and it requires the participant to learn some technical skills (technical "know-how"), before playing the actual game was regularly highlighted. One participant, P1F1, indicated,

"That one (Xbox), I would hate to do that (setting up). Anything technical like that I'll dumb foul. If somebody set it up, shows how to do it … then I got it, and I can do it".

One of the participants, P4F1, mentioned that playing the game on the console is not suitable for a physically challenged person while another participant, P1F3 mentioned that she does not want a huge screen in her living room. Table 5.18 shows the conversation between P1F3 and P4F3 with regards on P1F1's feedbacks.

Table 5.18 Response by participant on Console

ID	Quote
P1F3	*It's not for me...it's not something I bother? All other things also the issue is that, in my living room or any living room that I've ever been in. I always travel, to actually clean space and wide screen... Cleaner screen and the space to do this thing. The setup.*
P3F3	*You do need a bit of space, Don't you?*
P1F3	*Yeah... and also I found they are getting it setup to work.*

With regards to the disadvantages of the tablet-based platform, participants indicated that the table has a smaller screen. Thus, it resulted in less immersion and lack of physical elements when compared to the console-based platform. One of the participants, P3F1, stated that she needs more time to understand the instruction and sometimes delay in response from the system made the tablet games boring, pointless and frustrating to her.

The participants aged 66-70 showed a higher level of engagement during gameplay using console due to the comprehensive displays and social interaction it offered. One participant from this group range commented on this aspect:

"Console games were very attractive to me – greater possibility of whole body interaction than I previously thought" (P1F4)

Although a small number of the participants perceived the technology as difficult. *"Identifying controls may have taken a bit of time, but that would be expected for a first time with a particular item of equipment."* (P1F4)

However, tablet technology has gained a place and widely accepted among the participants. This may be due to its relatively lower price and portability factor. Additionally, participants generally agree that the advantages and real-life benefits that they experienced during the focus group sessions changed their perception towards the technology. This observation is best described by one of the participants, P1F4:

"They were generally stimulating and relaxing at the same time." (P1F4)

A statistical test was conducted to obtain the relationship between the age groups of participants and the platforms used. A *Kruskal-Wallis test* analysis (x = 1.857, df = 3, p = 0.603) indicated that the relationship between age does not significantly different between both platforms. This is contributed by unequal number of participants in each age group. It shows that the age group of 66-70 was very distinct and has the highest mean compared to other age groups.

Table 5.19 Relationships between Gender, Age and Platform

			Gender	Age	Platform
Spearman's rho	Gender	Correlation Coefficient	1.000	-.528	-.149
		Sig. (2-tailed)	.	.052	.611
		N	14	14	14
	Age	Correlation Coefficient	-.528	1.000	.094
		Sig. (2-tailed)	.052	.	.750
		N	14	14	14
	Platform	Correlation Coefficient	-.149	.094	1.000
		Sig. (2-tailed)	.611	.750	.
		N	14	14	14

**. Correlation is significant at p < 0.05 (2-tailed).

The strength of the correlation between Gender, Age and Platform is shown in Table 5.19. Base on *Spearman's rho test,* there is moderate negative relationship between gender and age (r=-0.528) and very weak negative relationship between gender and platform (r=-0.149). There is very weak positive relationship between age and platform (r=0.94). However, all the relationship were not significantly at p<0.05. Finding shows that the older the age, the higher platform is preferred (console). Most of the participants, from all age groups preferred the console experience better than the tablet. Also, the higher amount of gender, the less platform

they will use. Most of the participants for this study were female participants from the age category of 55-60 (n=3), 61-65 (n=3) and 65-70 (n=3).

5.5.5.2 Graphical User Interface (GUI)

Any digital game can be represented as a 2-dimensional (2D) or 3-dimensional (3D) game. A 2D game only allows movement/interaction in 2 dimensions (e.g. the original Pong game, Pac-Man), while a 3D game allows movement/interaction in all three dimensions (e.g. Kinect Wii Sport Games, The Sims). With regards to 3D vs. 2D, eight participants agree that 3D type of GUI was more appealing to them. They stated that 3D interface was more realistic and stimulating. Brighter graphics also enables the game's user interface to be more interesting and appealing to them. P4F1 however, prefers the 2D interface where she described it as easier to see and navigate. P1F3 preferred both graphical user interfaces, where she claimed that both types of the interface will enable her to learn different sets of skill and this could be beneficial to her and older people in general. On the other hand, she also mentioned that some things (digital games) were better presented in 2D interface and vice-versa. This was correlation with regards to the challenges associated with the ageing, when people getting older, their vision will deteriorate. Thus, use of appropriate high colour contrast (Caprani *et al.* 2012) is preferred. This finding is linked with the finding found in **Section 5.5.4**.

5.6 Theory Quadrant: Games

5.6.1 Interaction Types

As mentioned earlier in **Section 5.3.2.1**, 64% of participants classified as non-gamer and only 36% were considered as gamer took part in this study. 11 out of 14 participants (79%) preferred to interact with the console games (*Kinect Sports – Bowling and Skiing*) compared to tablet-based games. These participants stated that the '*challenging'* factor as their main reason for such selection trend. Based on their feedbacks, they found it to be more challenging (and fun) for them to move physically (i.e. some form of exercising). Also, the strategy aspect of the game (thinking of how to win the game) could potentially help them to be mentally active. Participants also pointed out that they could relate the games played via

console with the real life situation. Furthermore, it is deemed to be more interesting and fun to play with based on the participants' feedback.

These games also encourage active social interaction among participants and emphasise cooperation/competition between them. Playing *Bowling* on the tablet was considered boring as it only involves limited functions such as zoom-in, zoom-out and swipe with one finger with no body movement involved. One participant, P1F3, compared playing the *Bowling* game on both platforms by stating,

"*I'll get bored with that actually 10 minutes flash* (*Bowling* game on tablet). *This is not physical at all. I just used my finger*".

The participant also asserted,

"That game on tablet you can't completely control a game. On the console thing, it's a physical game. On that (tablet), it's more like just any other game where you are just having some move character around with your finger".

The participant also mentioned that playing the *Bowling* game on a tablet will remove all the physical aspect from it and it has become pointless.

With regards to *Car Racing* game, all participants unanimously enjoyed its gameplay, where it was observed that they compare their time lapse among themselves. Playing car racing was deemed as something new and exciting, particularly among the female participants. The game also encourages active social interaction among participants and emphasises cooperation between them. The participants demonstrated an interest in playing games on the device after participating in the study. For example, one participant (who has 'hand tremor') was impressed to see that he could play the *Car Racing* game using a tablet which he would have never thought of doing it before. He learned to play the games by tilting the tablet to the right and the left, similarly with navigating a steering wheel in a real car. "*I was pleasantly surprised by some features on the tablet (mainly the steering by tilting it – I hadn't thought of that as an option before the session), and the details visible were better than I would have thought beforehand*." It showed that the participant learned new knowledge and gaining new experience, when playing the *Car Racing* game on the tablet and learned new skills by discovering the functions on the tablet (tilting to imitate steering wheel).

5.6.2 Gameplay Interaction and Challenges Associated to Ageing

When it comes to challenges normally faced by older people, it is usually associated with age-related changes. Normally, older people will go through countless changes in different levels such as changes at the perceptual, cognitive and psychosocial (Kaufman *et al.* 2014). It is mentioned earlier in Chapter 2, to capture the adequate interaction between players and the games, the aspect of user experience, needs and interests should be considered and examined.

Thus, feedback and suggestions from the participant's interaction and experiences were taken into consideration in this study. Similar finding as (Whitcomb 1990, Ijsselsteijn *et al.* 2007, Flores 2008) was observed, where age-related declines such as in physical and cognitive functions could influence gameplay (i.e. needs, preferences) for older people. Participants emphasised that simple and clear instructions (i.e. written, auditory) should be included in the game. One participant, P4F3, mentioned that:

"…be viable both ways because actually when you are looking at the screen, something in your ear telling what to do is good. For me, there are people don't hear very well. So they got to have it and on the screen".

While another participant stated, P1F1,

"They must not be written in a lot of technical jargon".

Simple and fewer elements in interface design were preferable (i.e. not require too much working memory) is also mentioned by a participant, P1F3:

"I also think you don't want too much extra stuff on the screen that you don't need. I just want to see what the stuff that I got to deal with not allowed other stuff around".

Participants also added they would like to have an adjustable interface, with regards to font type and size as well as screen resolution. Below is one example responses quoted from the participants.

"Need to make sure the printing is big. I couldn't see that straight. My glasses need changes. Older people needed big, bold print" (P1F1)

Meanwhile, another participant, P4F3, stated he wanted control over the brightness of the screen and also the volume of the platform which could be helpful for those who have eyes

sight and hearing problems. Two participants further stated that the game timer should not be included;

"I don't like time limit thing" (P1F1)

"Because some people take longer to learn things than other" (P3F1)

The participants also asserted that they would like to play games that required less physical and memory strength, such as playing without any input device (i.e. controller) and body movement (i.e. physical game). One participant suggested a tutorial or instruction screen need to be included and displayed before the gameplay started. This screen will briefly show what they will see and what they have to do in the game. This screen also can be skipped and referred whenever needed. This is important to be included as older people are likely to encounter decline in cognitive abilities. As stated by the participant, P1F3,

"My dad nearly 91, and he got very bad short term memory so you can tell him something - but you know... he said 'yeah, it's fine.' If you set him off and play it. He enjoyed doing it, but the next time he picks is up he not remembers what he got to do. He's very much a target person that would be useful to get him to do something slightly different because he needs to exercise his brain to retain the ability to do things".

On the other hand, typing can be replaced by voice recognition while touch screens can be helpful when having difficulty with wrist/elbow movement required when using a mouse. The natural interaction offers in console become the main attraction to the participants.

Older people also prefer to have control over what they do. This is associated with andragogical perspectives where the older people are an independent self-concept and who can direct/control his or her own learning (Knowles 1984). This is observed in our study where the participants mentioned that they have a total control playing the game using console compared to a tablet. Feedbacks from two participants on their experiences playing *Bowling* game using the tablet as stated below.

*"Yeah, the ball doesn't go where it supposed to go. *Chuckles* You know, you think it go ...You don't get the control ability"* (P2F4)

"... on tablet you can't completely control a game. On the kinect thing, it's a physical game. On that, it's more like just any other game where you just having some move character around with you finger" (P1F3)

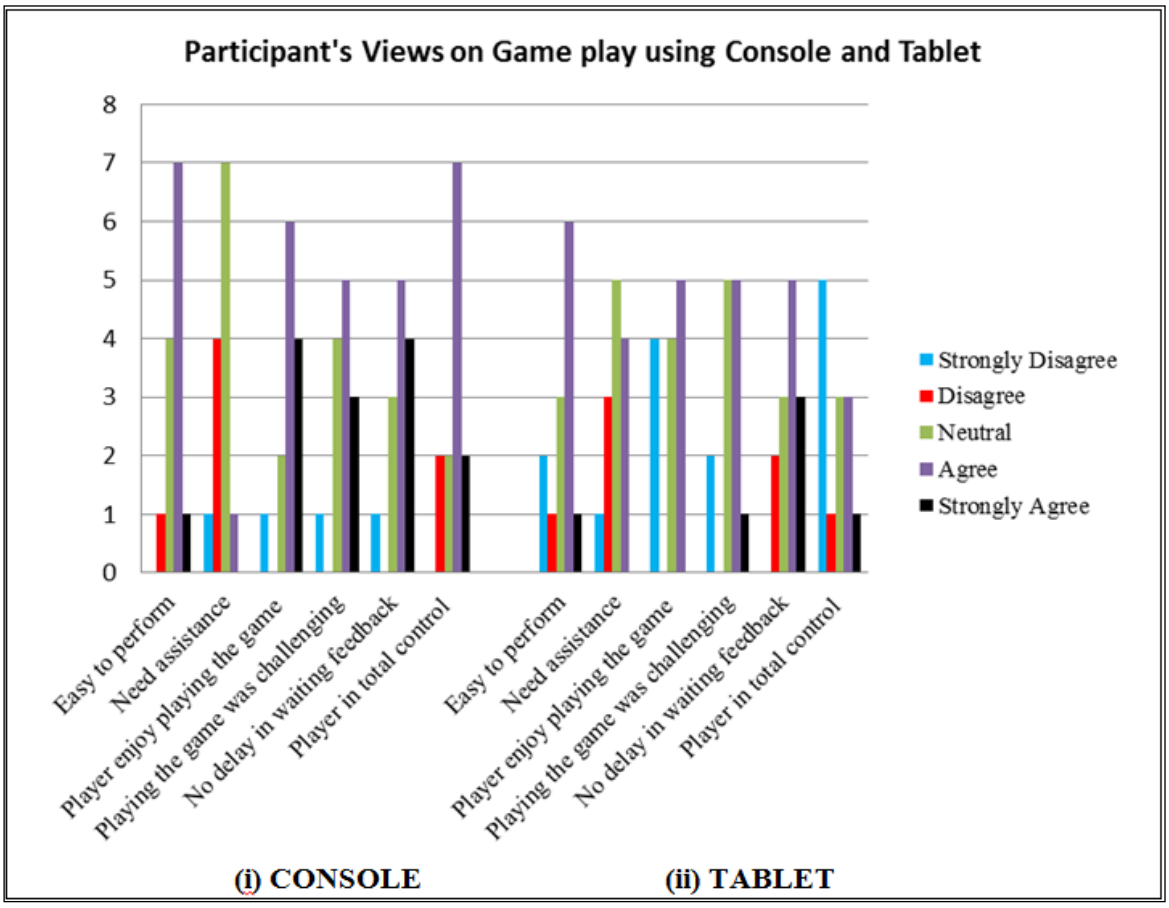


Figure 5.9 Participant's view on game-play using *console* and *tablet*

The gameplay using different platforms are evaluated using six criteria; *Easy to perform, Need assistance to perform the game, I enjoy playing this game, Playing the game was challenging, I did not have wait feedback too long,* and *I felt in total control of my playing actions.* Figure 5.11 illustrates the views from the participants after interacting with both platforms, addressing these six criteria. *Mann–Whitney U* test was conducted and shows a significant difference between console and tablet for two items; *Player Enjoy Playing the Game* (U (25) = 35.5, Z = -2.671, p = 0.008), *Player in Total Control* (U (25) = 44.5, Z = -2.130, p = 0.033).

The result reveals that when the older people were in a total control of utilising the platform, they found enjoyment and engagement in playing the game. This result strengthens the finding where the older people found that it was easy to operate the console. Besides that, it also offer appropriate user interfaces (i.e. better graphic, big screen). Furthermore, it indirectly brought the fun element to them. This result is directly proportional to the

andragogical perspective, regarding the older people's need to take control over their learning (i.e. utilising the platform) and enthusiasm towards learning activities they are participating in (i.e. playing games) (Knowles 1984). Meanwhile, no significant difference was found for the rest of the criteria.

The study findings also show that participants preferred a tablet over the console. This preference was influenced by three factors which were cost, technicality and portability. Through the focus group sessions, finding shows that size, weight and battery lifespan of the tablet were the main reason the older people (particularly the participants) prefer the tablet rather than the console.

Besides all these, feedbacks from the participants also show that the platform physical characteristics needed to be taken into account as a serious consideration when designing a game, specifically for older people. Size and weight of the tablet would affect those people who have joint pain (i.e. arthritis). One participant, P1F3, mentioned:

"*That particular tablet, it's quite heavy…. Again, if you talk to older people who may well find their wrists are not that strong, it might be awkward to manipulate. Because it's quite heavy".*

Therefore, a selection of size and the lightweight platform is important in this research so that it will not bring any effects to the participants. In other words, less strength/energy required to hold and navigate the platform. Meanwhile, tablet battery lifespan also needs to be prolonged to show the reliability of the technology to gain acceptance within the participants *"… I think, for me the issues always about how reliable the technology is and in terms of battery life to remember ... you know, if it... while I touch stuff on my last phone I had. The battery drained so quickly".* However, this study will not discuss more on the technical factors such as battery lifespan and size and weight of the platform, as it is not relevant to this research aims.

Interaction is needed in designing a game for older people to promote active social interaction. Confidence barrier such as afraid of taking part when it involves new technology could be among the challenges that caused the older people to be less enthusiastic about technology, apart from less self-confidence in interacting, trying new thing and involving themselves in such activities. Therefore, interaction is needed to ensure that the older people can be more confident when interacting with others, especially when it comes to interacting

via technology (i.e. digital games). During gameplay session, participants are encouraged to work together among themselves (team effort). Through this style of engagement, participants collaboratively discuss their strategies (to achieve the goal) and it turns out to be a better mechanism to allow participation among all of them when compared to single player. Apart from that, feedback from the participants also shows that they found the gameplay is more challenging, motivating and fun at the same time.

5.6.3 Gameplay Experience

From the observation, participants' perspectives on the perceived difficulties and benefits of digital gaming were influenced by their confidence barriers related to their first impression, their perception of engaging with something new (i.e. technology) and their perspective towards the relevance of technology. Thus, the following subsections discuss these points further as part of this research finding.

5.6.3.1 Something New or Beneficial

Several participants mentioned that they owned a tablet due to the portability and affordability of the device. The participants demonstrated an interest in playing games on the device after participating in the study. For example, one participant (who has 'hand tremor') was impressed to see that he could play car racing using a tablet which he never thought of before. He learned to play the games by tilting the tablet to right and left as the real steering wheel of a car. *"I was pleasantly surprised by some features on the tablet (mainly the steering by tilting it – I hadn't thought of that as an option before the session), and the details visible were better than I would have thought beforehand"*.

By taking this example, it shows that the participants obtained new knowledge, which was relevant to his point of view. He discovered that tablet has more function that he originally thought, where tilting to imitate steering wheel is concerned. Thus, it encourages the participants to engage more with the technology and increase positive perception not only towards the technology but also towards digital games specifically.

Based on the andragogical perspective, it would be easier for someone to learn something or use something new if it has relevance or beneficial to them. People will only interact with

something familiar, interesting, meaningful and beneficial to them. As quoted by one of the participant, P4F3,

"… if you would to offer me a serious driving... to improve your driving skills or an aircraft simulation or something. I might be more interested. But, that's maybe because I am an engineer and more interested in that type of thing".

5.6.3.2 Social aspect: Peer support

With regards to peer support element, the finding shows that 77% of the participants prefer to engage with the digital games alone, compared to 15% otherwise (having company to play with). Several studies show that older people like to play digital games with their family members and friends, which encourage social interaction and reduce the digital divide among the intergeneration (Khoo *et al.* 2006, Keyani *et al.* 2005). They changed their perspectives when they had seen their family members or friends playing it. Responses from two participants regarding playing digital game (i.e. crosswords) together:

P4F3: "… I notice my newspaper is part of the package that you get a guide in it and you get the crosswords. Now, at the moment, we have one paper -newspaper and if we both do the crosswords... I have to do in the little piece of paper before"

P3F3: "And one of us can do it online...that's true. I never thought of that"

As described in **Section 5.5.5.1**, one of the reasons why certain sections of older people prefer to play the game using the console is because of the social aspects (interaction) it offers. Older people will perceive playing games with family members (i.e. grandchildren) and friends could be used as a social support (medium for social interaction). Another participant stated that she enjoyed the social interaction with family members while playing games. *"I had played a console game before at my brother's house on Christmas day. I think it was very funny to play with them (playing tennis games). And we have a situation that is funny… ask another person to move a little bit… *laugh*".*

This is in line with the andragogical perspective, where adult learners are more interested in learning or do something that has immediate relevance to them (work or personal life). In other words, they prefer to engage in something that is important or beneficial to them. However, such perspectives can change based on our findings. For example, five participants

in this study change their point of view from reluctant to use new technology (such as digital games), to agree to try these technologies once they realised the benefits and observing other participants' session. One participant who mentioned had a knee problem and would not join game-play session (using the console), changed her mind and joined the session once she saw other participants were having fun and experiencing something new and beneficial. Several other participants mentioned that they would play the game again as they find it fun and at the same time the game was perceived to stimulate their brain and lead to body movement associated with some form of exercising.

5.7 Discussion: Correlation between Research Findings and 4 Quadrants

Figure 5.12 below shows the four main components that were adopted in this study. The quadrants were based on 4DF framework and synthesis of different frameworks and model (MDA, 4DF, RETAIN and ADGBL) from different publications (e.g. articles, journals) by previous researchers.

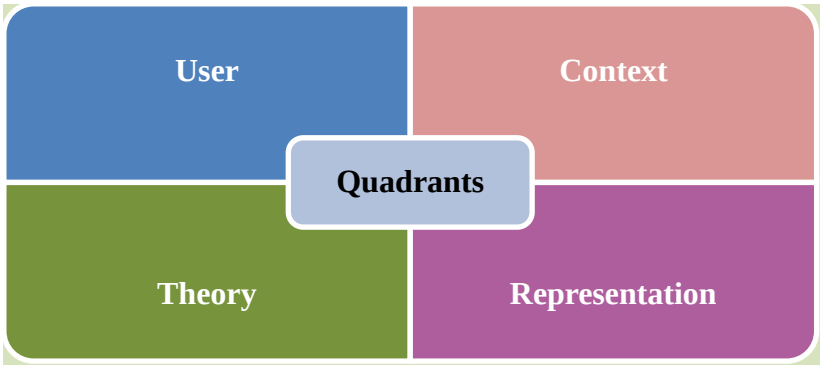


Figure 5.10 Main components of proposed research project

The correlations of the data analysed from Phase I (Preliminary Study) with the components were listed as follows:

- Based on findings, the data collection focuses on four components: *learner* (e.g. challenges faced by older people, technology acceptance among older people), *context* (e.g. home base, care centre), *theory* (e.g. andragogical perspective) and *mode of representation* (e.g. mechanic, dynamic and aesthetics). *Mode of representation* component was presented and divided into three main segments which are mechanic, dynamic and aesthetic.

- With respect to game design for older people, different game *mechanics* or game attributes (e.g. *rules, goals, control, fantasy, interaction, challenge*) and user interface need to be considered besides investigating the users' interactions and experiences. As mentioned earlier in Chapter 2 and 3, older people have specific gaming needs and preferences. Thus, user experience and sufficient information need to be examined and provided to capture an adequate interaction between players and the games. It is essential that users or players are captivated and engaged by the game before any serious purposes/activities can be imposed. Based on the findings, several game attributes have been tested in the questionnaire (refer questionnaire Question 8, Section 2 and Question 4, Section 4). Among them were *Mastery, Immersion, Social Interaction, Competition, Narrative, Cooperation, Integrated Theme,* and *Intellectual Challenge*. For example, the social interaction can be defined as a relationship between a player with other players, and games become a medium of interaction Fezzani *et al.* (2010). Based on the finding, while playing games either on tablet or console, the older people interacted with each other. It also encourages older people to play and help each other (cooperation). Likewise, a game with social aspects inspires healthy competition between players which might offer challenges or quests; to keep them healthy and socially active. For example, when playing *Kinect Sport: Bowling*, P1F1 was helping P2F1 on how to throw a virtual bowling ball, at the same time both participants informed each other on their scores (competition). The findings from the analysed data through observation show that the participants were fascinated by these types of interactions – social interaction and interaction with the equipment (i.e. console). When playing games using the console, it not only encourages active interaction among the participants but as well offers natural body movements. This interaction has more degree of freedom or offers natural interaction that also leads to some form of exercising. Thus, three types of interaction have been considered which are an interaction (equipment), interaction (interpersonal) and interaction (social). However, when it comes to buying a platform, majority of the participants prefer touch-based interaction compared to gesture-based interaction which is influenced by three factors; 1) cost, 2) technicality and 3) portability (refer **Section 5.5.5.1**).

- In this Phase 1, list of game attributes/mechanics were identified (Table 3.1). Several attributes/mechanics have been tested as mentioned earlier. The rest of the game attributes will be tested in Phase 2 (*Further Investigation Study*). In Phase 2, the game

attributes and game design considerations specifically for older people were further identified and selected. The selected game attributes and considerations later can be used to design game focusing for older people. Further discussion on the game attributes is explained in **Chapter 6.**

- With regards to the finding of the game *dynamic*, most of the participants participated in the focus group mentioned that they were more interested in playing an individual game or single player (refer **Section 5.6.3.2**). Also, with regards to the *context* component, older people stated that they prefer to play the game at home, either playing alone or with friends or family members, but not with a stranger as they feel insecure when playing with the person they do not know. A balanced number of participants prefer to play console or tablet (refer **Section 5.5.5.1**), **Section 5.5.2** already shown that the users' interaction and experience of gameplay's findings using different platforms. It also describes the features of the platforms (e.g. screen, icon/button, interface capabilities) that consider the challenges associated with age-related declines. From the analysed data, it shows that the ease of use for both platforms can reduce participants' anxiety and change their perspectives and attitude towards technology, especially digital gaming. Furthermore, this will also turn their anxiety (perceive difficulties) to fun, enjoyable and interested in learning new thing.

- The *aesthetic* aspects of the game and the platform were discussed in **Section 5.5.2**. It discussed the other platforms features such as screen size, font size and font type; *icon/button, navigation, interaction* and *multimedia*. The findings show that aesthetics play a huge role in designing a game targeting older people. Consideration of aesthetics and human-computer interaction (HCI) were also important in selecting an appropriate platform for older people. Caprani *et al.* (2012) asserted that older people perform better and prefer to use touch screens compared to other input devices. They addressed several guidelines for designing touch screen interfaces. The main areas that were covered were the screen layout (e.g. screen size, font size, and colours), button size and spacing, menu structures and data entry. Also, Fezzani *et al.* (2010) reported older people were preferred to look at large targets (button, icon), compared to small targets. Larger features offered large input and output (e.g. screen size, font size) and supported pointing accuracy. It will also benefit older people with vision problems. The colours used were also considered

and had been discussed in **Section 5.4**. Multimodal input and output could support and improve the usability of a design for older people. Speech and eye-gaze were two data input that can be considered, but still not been commonly be associated with touch screen technology (Caprani *et al.* 2012). However, speech input will benefit older people with vision problems and motor difficulties associated with age-related declines such as arthritis or tremble. For eye-gaze, it would support older people with motor and physical difficulties that have a problem with mouse and touchscreen specifically.

- With regards to *theory* component, andragogy theory was referred in this study (refer **Chapter 2, Section 2.7**). As mentioned earlier in Chapter 2, *Andragogy* - the art and science of 'helping' adults learning which is used to differentiate two learner groups, adult and children (Knowles 1984). It shows that the way adults learn or perceive a certain aspect is different from children. Therefore, to promote learning for an adult will require a different approach, through adopting the andragogical perspectives. In this study, the andragogical perspectives were correlated with other findings such as participants' perspective and attitude towards digital gaming; and the challenges associated with ageing faced by this target groups. Based on andragogical perspectives, it would be easier for someone to learn something or use something new if it has relevance or beneficial to them. The finding shows that people will only interact with something familiar, interest them and meaningful – if the game has right context, dynamic and mechanics that would change the perspectives of someone who would refuse to play. From the finding, most participants like to play the game alone. However, some of the participants prefer to be accompanied while playing games. Several studies show that older people like to play games with their family members and friends which encourage social interaction and reduce the digital divide among the intergeneration. They changed their perspectives when they had seen their family members or friends playing it. This also reflected by the finding in this Phase 1 analysis (refer **Section 5.6.3.2**). Besides that, several participants found that by playing the game it could activate their brain by stimulating it, and they could exercise and have fun at the same time. This is in line with the andragogical perspective, where adult learners are more interested in learning or do something that has immediate relevance to them (work or personal life). In other words, they prefer to engage in something that is important or beneficial to them. However, such perspectives can change based on the findings. As an example, five participants reluctance of using new technology such as games changed once they realised the

benefits and observed the practice of others. One participant who mentioned had a knee problem and refuses to join gameplay session (using the console), changed her mind and joined the session once she saw her friends having fun and enjoying themselves. Other participants mentioned that they would play the game again as they find it fun and at the same time the game was perceived to stimulate their brain and lead body movement associated with some form of exercising. Other finding found in this study shows that the older people prefer to have control over what they do. This is in line with andragogical perspectives where the older people are an independent self-concept and who can direct/control his or her own learning (Knowles 1984). This is showed in this study when the participants mentioned they have a total control playing the game using console compared to tablet (refer **Section 5.6.2**). This result also appears to be statistically significant as performed by the *Mann-Whitney U test*.

5.8 Summary

It is essential for the perspectives and perceptions of older people to be considered when selecting and/or designing games for this target group. The results of our study show that there are several key components that should be considered when considering the interaction and experience of older people with digital games. These components are; 1) views on digital games, 2) the perspectives of engaging with different platforms, 3) the interaction types and the experience provided by the game itself looking at the interaction with the equipment (including devices, platforms) and engagement in terms of meeting the interpersonal and social needs, 4) the game interaction styles supported by the platforms looking at the degree of freedom and autonomy the platform provides, portability and ease of use, and 5) gameplay interaction and experience; and challenges associated with age-related changes. However, these results are preliminary. The next step will involve further investigate and validation phase of the preliminary findings by conducting a larger scale of data collection with further analysis to explore more on the user interaction and experience focusing on older people.

CHAPTER 6

FURTHER INVESTIGATION STUDY: RESULTS AND ANALYSIS

This chapter presents the analysis and findings from the Phase 2 (*Further Investigation Study*) of data collection. Data collected from this phase were used to further investigate the findings derived from Phase 1 (refer Chapter 5). Section 6.0 present the introduction of the chapter followed by a discussion of data analysis collected in Phase 2 in Section 6.1. Section 6.2 until Sections 6.4 discus the data findings regarding the designated four quadrants *(users, context, representation* and *theory*). Findings from the statistical and qualitative analysis are discussed in Section 6.5. In Section 6.6, the findings are highlighted and discussed based on the four quadrants, research questions and hypothesis. Lastly, the summary of this chapter is presented in Section 6.7.

6.1 Introduction

The validation phase or *Further Investigation and Validation* was conducted to validate findings that have been derived in Phase 1: *Preliminary Study*. Two tests were carried out; (1) Test 1: Disseminate survey; and (2) Test 2: Focus Group. The details are already presented in **Chapter 3, Section 3.6.4.2.** These tests were carried out to explore the previous findings in more depth and to validate research's hypotheses, which had been previously derived. SPSS 22 version was used as a tool for conducting an appropriate test in helping with statistical analysis of quantitative data.

6.2 Data Analysis

Data analysis was an important process in this study to answer the research questions. Data was examined and categorised as parametric and non-parametric data. The reason for doing so is to choose the appropriate and accurate statistics procedure in order to analyse the data. Non-parametric tests were identified as appropriate to analyse the data due to clear situations where the data collected in this study has a non-normal distribution. These include situations where the data outcome was categorical (nominal) and an ordinal scale data or a rank. The sample sizes were also playing a role in choosing the correct test in this study. For this study, the sample size was considered small (Phase 1, n=14; Phase 2, n=100 survey participants,

n=10 focus group participants) thus non-parametric tests were applied. Compared to a larger number of samples, it will be more normally distributed and variation will be less. Therefore, the parametric tests could be used. As a result, in this study the sample size and normal distribution of data were the major factors when identifying the appropriate and correct tests to use in analysing the data.

Due to the situations mentioned above, this study (Phase 2) has identified several non-parametric tests that were used to analyse the data. Among the tests were the Mann-Whitney U Test and Chi-Square Test which were used to compare statistical results between participants or participants with other variables (i.e. age, previous experience using technology, previous profession).

The four key quadrants are further expanded in this chapter and the related research design is presented in **Chapter 4**. The findings reported in this chapter enabled further validation of the data and observation obtained (from Phase 1). Eventually, these findings were also answering the research questions and the aim of this thesis.

This phase elaborating further the analysis with larger scale data from the survey paired with focus groups. Therefore, the findings discussed in this chapter were based on data analysed from a survey of 100 respondents and a series of focus groups of 10 participants. Questions and activities (i.e. choices of games) for the survey and focus group (in Phase 2) were formed based on the results and outcomes derived from the *Preliminary Study* (Phase 1).

6.3 User Quadrant: Demographics Characteristics and Technologies Usage

Respondents from seven countries participated in the survey. These countries were Australia, Italy, Malaysia, Spain, Thailand, United Kingdom (UK), and United States of America (USA). Figure 6.1 represents the percentage of respondents from the seven different countries that took part in this survey. The largest number of participants was from the UK (82%). Meanwhile, both the USA (6%) and Australia (6%) were the second largest country followed by Thailand (3%), Malaysia (1%), Spain (1%), and Italy (1%) respectively.

Although the responses were obtained from seven countries, this research considers only the responses from the respondents who were residing in the UK (82%). Due to the largest

respondents (82%) were from the UK and the target scope for this research project limited to those who are living in the UK (specifically Coventry, UK). Later, the focus groups were recruited from these respondents. Thus, responses from other countries will not be included in the analysis. However, it can be referred as a reflection to the research findings.

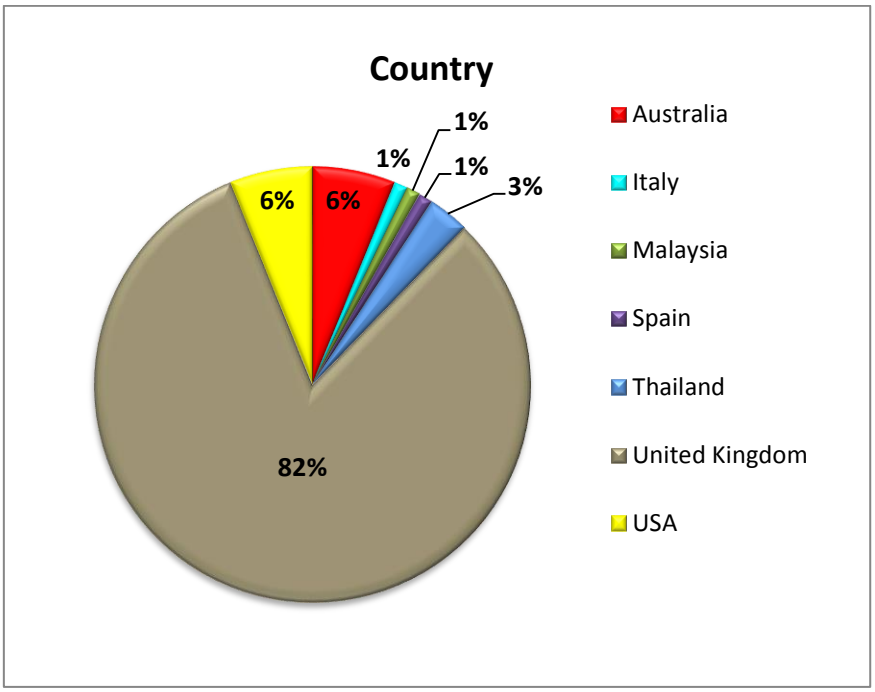


Figure 6.1 Percentage of survey's respondents from different countries

Participants from fifteen different cities in the UK had taken part in this survey. The total number of respondents from each city and the view of respondents' location maps were shown in Table 6.1 and Figure 6.2 respectively. The majority of the respondents were from Coventry (59%, n=48) followed by Bristol (13%, n=11), Leamington Spa (6%, n=5), London (5%, n=4), Belfast (2%, n=2). Birmingham (2%, n=2) and 1% (n=1) each from other cities.

Table 6.1 Total number and percentage of respondents from different cities

City	Total of respondents	%
Coventry	48	59%
Bristol	11	13%
Leamington Spa	5	6%
London	4	5%
Belfast	2	2%
Birmingham	2	2%
Bromsgrove	1	1%
Cardiff	1	1%
Didcot	1	1%
Guildford	1	1%
Hereford	1	1%
Huddersfield	1	1%
Newcastle Upon Tyne	1	1%
Reading	1	1%
Swindon	1	1%
Worcester	1	1%

Figure 6.2 Geographical views (map) of respondents' location

Referring to Table 6.1 and Figure 6.2, majority of the respondents were living in the England with only three respondents were from outside of England. From 82 respondents, a significant majority of the respondents (69.5%) were White British as illustrated in Figure 6.3. A further 13.4% were Asian other/Asian mixed and 4.9% were African (Black/Black British). 3.7% participants were White other and Indian (Asian/British Asian) (each) while

1.2% (each) were Pakistani (Asian/British Asian), Caribbean (Black/Black British), Mixed Heritage (White and Black Caribbean) and Other (African-White).

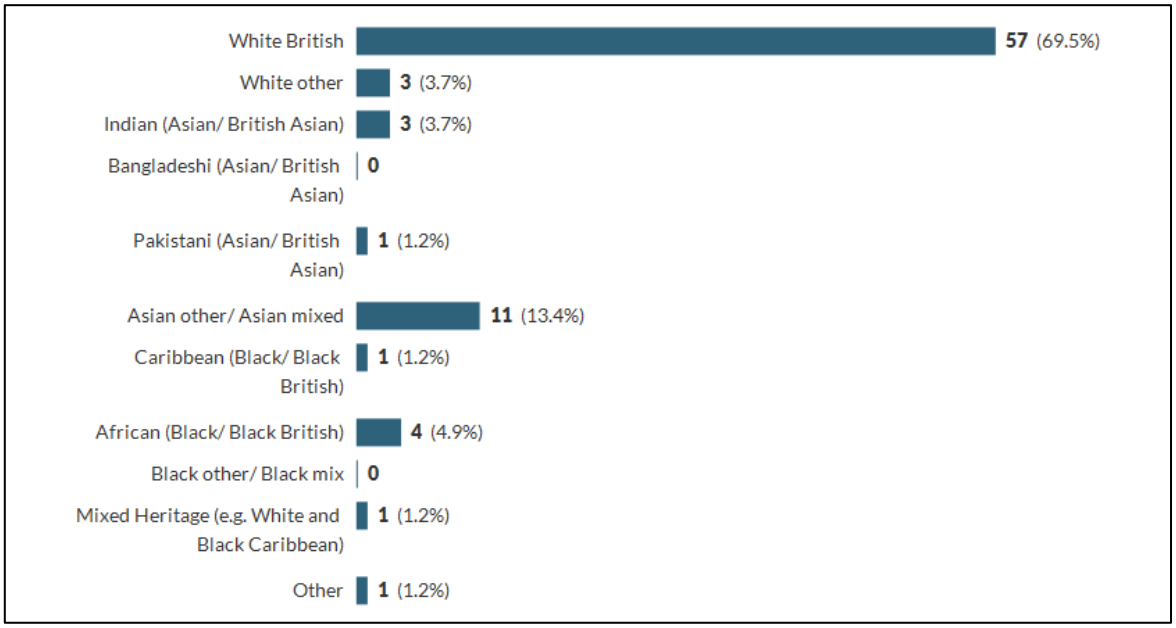


Figure 6.3 Percentages of Respondent's Ethnicity

With regards to the UK-based respondents' (82% of the total number of respondents) gender, there were no distinct differences in terms of number. From Phase 2, 51% of the UK-based respondents are male (*n = 42*) and 49% are female (*n = 40*)

With regards to the focus group sessions, 10 participants took part in the study with a balanced number of male (*n=5*) and female (*n=5*) participants. All participants were recruited from Coventry with the majority of the participants being White British (60%, *n=5*), while 20% (*n=2*) were Asian other/Asian mixed and 1% (*n=1*) each were Caribbean (Black/Black British) and Pakistani (Asian/British Asian).

The age of all participants for the survey conducted was ranging from 55 to 77 years old. Figure 6.5 and Figure 6.6 show the participants' age demographic. Participants of 55-60 year-of-age dominated this study (37% with *n*=30, Male=14, Female=16) followed by 61-65 (22% with *n*=18, Male=8, Female=10), 66-70 (19% with *n*=16, Male=10, Female=6), 71-75 (13% with *n*=11, Male=6, Female=5) and Over 75 (9% with *n*=7, Male=4, Female=3). The average age of participants was 64.59 (MEDIAN: 61-65).

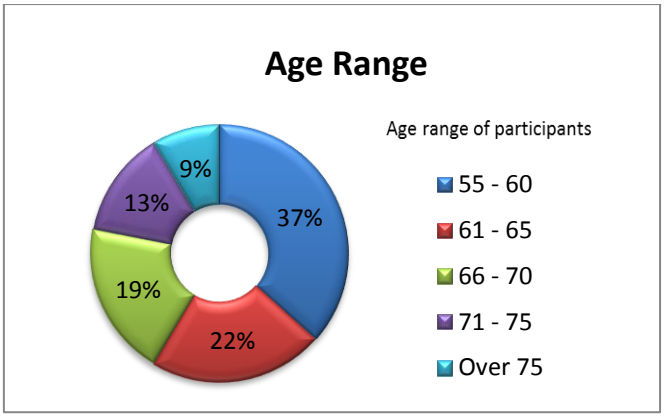
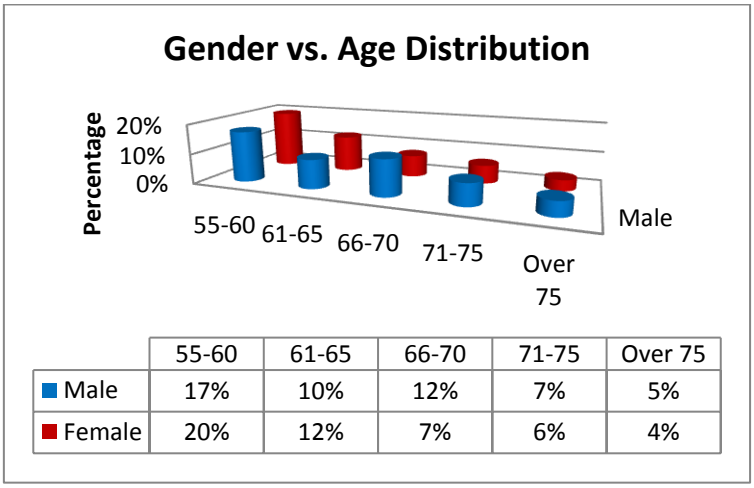


Figure 6.4 Participants' age range percentage (Survey)



	55-60	61-65	66-70	71-75	Over 75
Male	17%	10%	12%	7%	5%
Female	20%	12%	7%	6%	4%

Figure 6.5 Gender vs. Age Distribution (Survey)

With regards to the focus group sessions, the age of the participants that took part was between 55 to 75 years old (no participants above 75 took part). Figure 6.7 depicts the percentage of participants who took part in the focus groups based on age group and gender. The finding shows that there were a balanced number of participants (*n*=5 each) from both genders, male and female. It also shows that participants from the age groups of 55-60 and 66-70 have the same total of participants (30%, *n*=3 for each group). However, all participants from the age group of 55-60 were females (*n*=3, Female=3) compared to a mix gender in 66-70 (*n*=3, Male=2, Female=1). Table 6.2 shows the demographics background of participants who took part in focus group sessions.

Table 6.2 Participant's Demographics (Focus Group) including their *Postcode, Age Group, Gender* and *Ethnicity*

No of Participants	Participant N^0	Postcode	Age group	Gender	Ethnicity
1	**P1F1**	CV1	61-65	Male	Asian other/ Asian mixed
2	**P2F1**	CV7	66-70	Male	White British
3	**P3F1**	CV7	66-70	Female	White other
4	**P1F2**	CV7	55-60	Female	Asian other/ Asian mixed
5	**P2F2**	CV4	71-75	Male	White British
6	**P1F3**	CV5	71-75	Female	White British
7	**P2F3**	CV2	66-70	Male	Caribbean (Black/Black British)
8	**P1F4**	CV3	55-60	Female	White British
9	**P2F4**	CV2	61-65	Male	White British
10	**P1F5**	CV1	55-60	Female	Pakistani (Asian/British Asian).

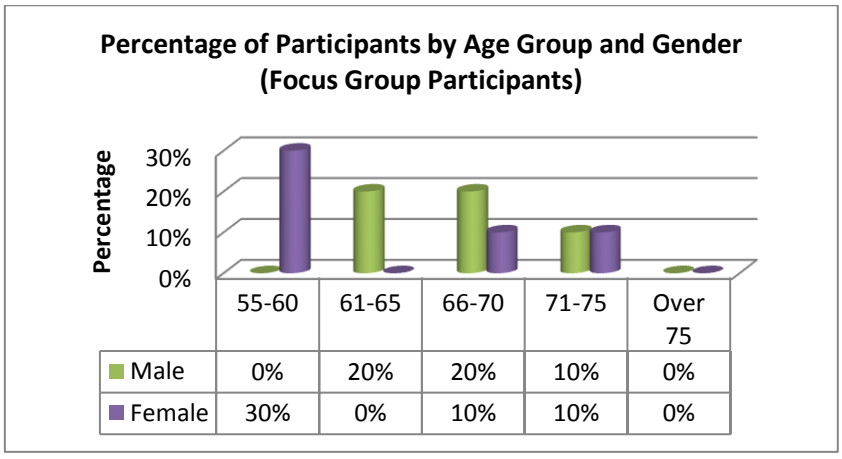


Figure 6.6 Gender vs. Age Distribution (Focus Groups)

Regarding the employment status, almost half of the participants (46.3%) were retired, 34.1% were full-time employed, 12.2% part-time employed, 2.4% self-employed while only 4.9% unemployed. While in describing computer literacy, more than half of participants (55.6%) considered themselves as a competent, while only 24.7% consider themselves as an expert, 17.3% novice and only 2.5% mentioned they have never used or non-computer skills.

With regards to the technologies usage, findings as in *Phase 1: Preliminary Study* (**Chapter 5, Section 5.3.2**) were mirrored. 23.9% participants reported that they owned a laptop, followed by smartphone (22.3%) and 19.7% had a personal desktop computer (PC). However, 26.8% participants claimed using PC most of the time rather than a laptop (25.6%), smartphone (22%) and tablet (20.7%). Having the reason, most of the participants had owned PC at home and some were using PC at the workplace. Notably, 86.6% (*n=71*) participants claimed to use the technologies daily for various purposes such as *email* (13.1%), *news, weather forecast and traffic information services* (11.3%) and *online shopping* (9.7%). This was followed by (<8% each) for *travel, financial, word processing, social media, video, music, streaming, GPS navigation, gaming, texting* and *outgoing/incoming call*. This finding shows that the older people perspectives are influenced by what they already owned.

Gaming versus Computer Skills and Age Range

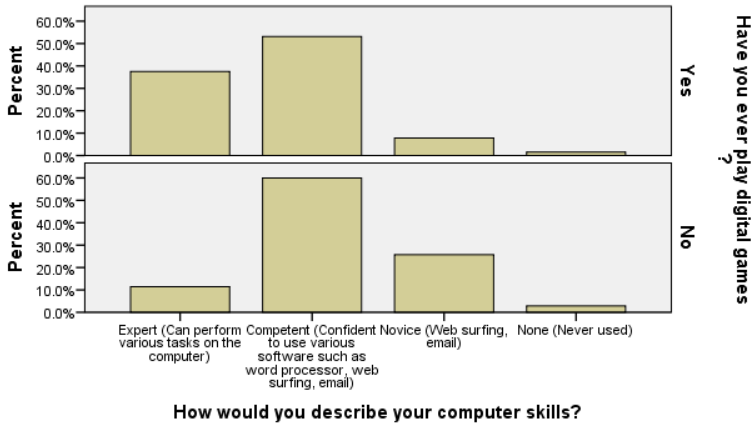


Figure 6.7 Gaming versus Computer Skills and Gaming Status

Figure 6.7 shows that participants who play games mostly regard themselves as an 'expert' (with more than 30%). Comparing to participants that never played game, 60% of them categorised their computer skills as competent. Figure 6.8 however, shows the gaming variables versus the age range of the respondents. This finding agreeing with the finding from the focus group which shows most of the gamer was from the younger older people (young adults: 55-60).

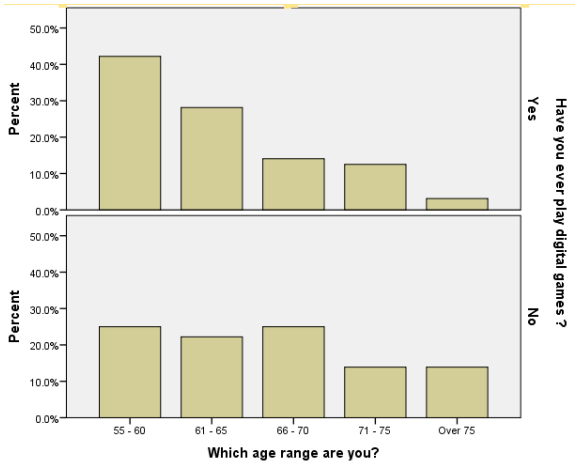


Figure 6.8 Gaming versus Computer Skills and Age Range

The Mann-Whitney test shows that the significant difference between the age range (p=0.049) and participant's computer skills (p=0.010). However, there is no significant difference found in other items. By looking at the gaming and computer skill, it shows that over 30% of respondents claimed themselves as an expert or a gamer. This is compared to 10% of non-gamer. Moreover, with regards to the age difference, it shows statistical significance by looking at the declining shape of the bar chart as shown in Figure 6.8. Those who were considered gamer were mostly from the younger group of older people (55-60, 61-65).

6.3.1 Participants' Gaming Activity

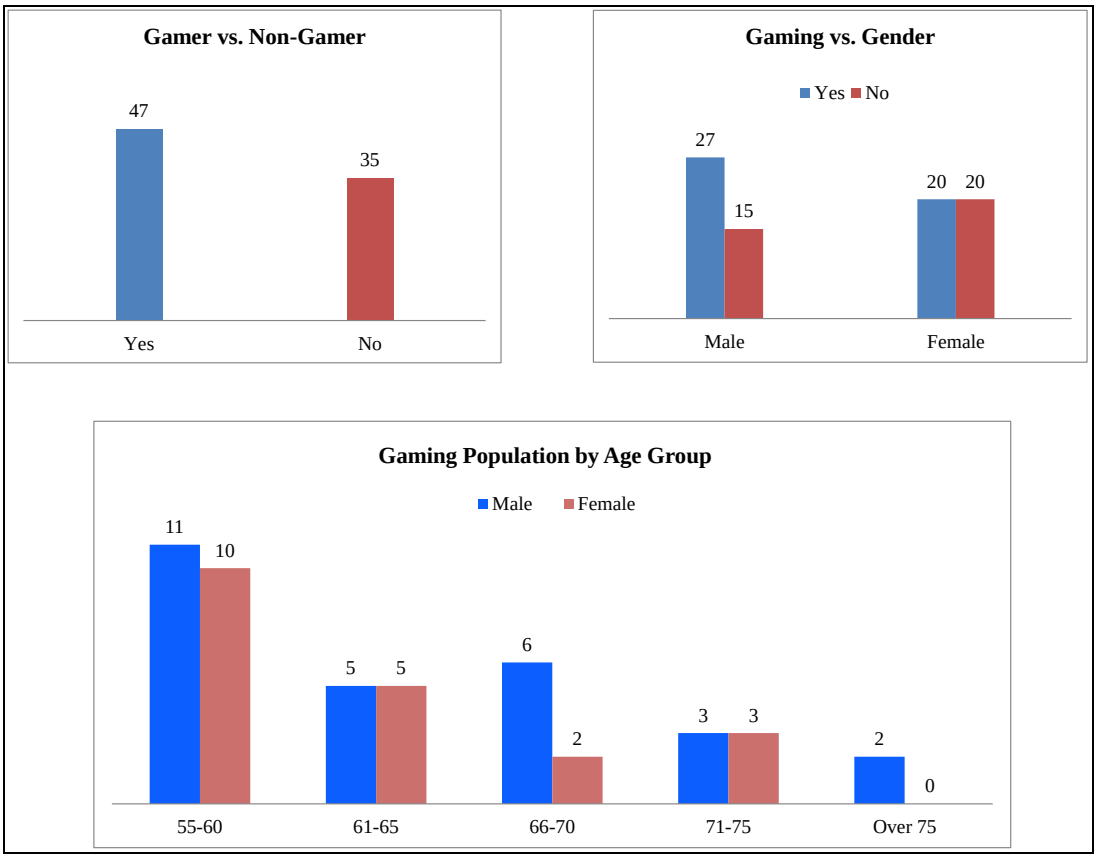


Figure 6.9 Participants' Gaming Activity and Demographic

In the questionnaire, all participants were asked if they have ever played digital games (any genres) before. As shown in Figure 6.9, 47 participants (57%) reported that they had played digital games and 35 participants (43%) never play digital games. It shows the difference in the frequency distribution was not remarkably differed between those who play games (Gamer) and those who never play games (Non-Gamer).

Based on Mann-Whitney test, there is no significance difference ($p=0.375$) between the gamers and the non-gamers in terms of how often they used the device in daily activities. Based on the findings, participants most frequently used the device at followed rank; PC (27%, n=22), laptop (26%, n=21), smartphone (22%, n=18) and tablet (21%, n=17). The findings also show that the participants who are classified as Gamer do not use the device/platform more frequently than Non-gamer. This is because most of the participants who played the game have various platforms (i.e. PC, laptop, smartphone and tablet,) that they owned and they used the platforms for different tasks and reasons. Reasons for using different platforms to perform tasks and playing games were discussed in **Section 6.4.1.**

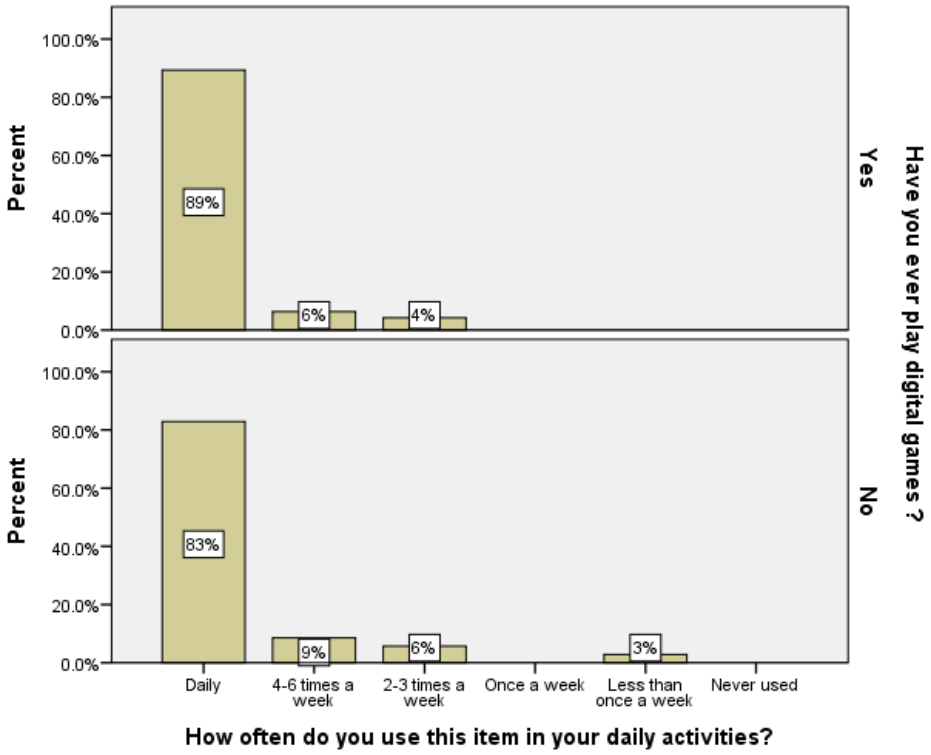


Figure 6.10 Participants' Gaming Activity and Daily Activities

89% of gamers are using the technology on a daily basis compared to 83% of non-gamer. There is no significance difference showed in this profile. The Mann-Whitney Test (refer above) is comparing this shape with one another. It shows that the shape of the bars is not remarkably different between the gamer and non-gamer.

In terms of the gaming comparison between gender, it showed that more male participants have reported playing game(s) compared to the female participants (27 (33%) participants of male compared to 20 (24%) of female participants). This finding also reflected the finding that was found in other research (refer to Chapter 2, ESA 2016, PEW 2015). The main reason given by the female participants was because they would prefer to meet people face to face (socialisation) and playing game was just a way to 'kill time' when there was nothing to do (i.e. waiting and sitting on tube, train, bus or coach) or to overcome boredom. However, in recent years, several researches found the increment in the population of females who were playing games. (ESA 2014) reported the number of female gamers above the age of 50 increased by 32% over the years. This finding not similar to the finding found in Phase 1 where more female participants than male participants. However, this does not represent the general population of this target group.

Based on the age group comparison, as expected, the large proportion of older people who were in the younger age groups (55-60 and 61-65) were more engaged in gaming activity compared to participants from older age groups (66-70 and 71-75+). This was due to older people within the aged of 55-65 were still working, active and familiar with the current technology and this age group was also more financially stable (refer **Chapter 2, Section 2.2.2)**. The distribution of age groups was summarised in percentage as shown in Table 6.3.

Table 6.3 Participants' gaming activity based on the age and gender groups

Age Group	No. of gaming participants	Gaming participants (%)	Male gaming participants (%)	Female gaming participants (%)
55-60	21 out of 30	70.0%	36.7%	33.3%
61-65	10 out of 18	55.6%	27.8%	27.8%
66-70	8 out of 16	50.0%	37.5%	12.5%
71-75	3 out of 11	54.6%	27.3%	27.3%
Over 75	2 out of 7	28.6%	28.6%	0.0%

Table 6.4 Participants' gaming activity based on employment status

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	9.037[a]	4	.060	.046		
Likelihood Ratio	9.981	4	.041	.058		
Fisher's Exact Test	8.702			.044		
Linear-by-Linear Association	1.439[b]	1	.230	.253	.137	.041
N of Valid Cases	82					

a. 5 cells (50.0%) have expected count less than 5. The minimum expected count is .85.

b. The standardised statistic is 1.200.

Pearson Chi-Square Test was conducted to perform a test to compare the respondents' employment status. Based on the finding, 45% of the gamer were employed as full time compared to only 20% of the non-gamer. Apart from that, it also shows that retired respondents have the reverse percentage, where the Non-gamers were more than the Gamers. This was shown using the Fisher's Exact Test where a significance of 0.044 ($p<0.05$) was observed.

Table 6.4 shows *Fisher's Exact test is (p=0.044)* which shows significance in both cases: "***There is a difference in employment in current profession between gamers and non-gamers***". It shows there was a different fingerprint of employment. In terms of the gamers versus the non-gamers, the big different is in the full-time employment. '***Most of these gamers are full time employed and can be assumed that a greater proportion of gamers that employed full time compared to the non-gamers".***

6.4 Representation Quadrant: Type of Interactions

As reflected by the findings in Phase 1 and Phase 2 (Survey), continuation on using platforms that offer natural user interfaces were used in this phase - Xbox 360 with Kinect (gesture-based interaction) and an iPad Air 2, iOS-based tablet (touch-based interaction).

Games that were selected in this phase were also based on Phase 1 and Phase 2 (Survey) outcomes. The majority of the survey's participants (64%, nine out of fourteen) and respondents (49.2%) prefer to play games that can stimulate their brains and at the same time could offer physical exercises as well as encouraging social interaction. Therefore, two games that meet this criterion were selected, namely *Dr Kawashima's Body and Brain Exercises for Kinect* and *Peak – Brain Training* (iOS/Android brain training app). Figure 6.11 below shows several images taken from the gameplay session with the participants during Phase 2.

Figure 6.11 Gameplay Session during Phase 2

The data obtained from these games were the participants' feedback especially on player's interaction and experience. It consists of participants' feedbacks on gameplay using console platform which most of the participants attracted to the physical movement that is gesture-based interaction it offered. Besides that, these games encourage and promote active interaction between players.

6.4.1 Gesture-based and touchscreen-based interactions

Reflecting on the findings in Phase 1, the use of the gesture-based and touchscreen-based interactions was interesting yet restrained. By using a gesture-based platform, it offers a natural user interface where the participants have to move their body to exercise their brain without holding something (i.e. controller). This can be observed when the players were asked to move their arms to form a moving bridge to guide cars to the right coloured destination. This was performed by swaying arms from side to side to swing an oscillating needle to the correct answer and lifting feet and kicking the soccer ball to the correct answer. The 'exercising brain' terms mean the exercise helps to increase blood flow, which benefits the brain, allowing the brain cells immediately function better. As results, people tend to be more alert during exercise and more focused afterward. Besides that, researchers (Kelin 2013) reported that exercising regularly could promote the growth of new brain cells. These new brain cells helps boost memory, learning and protect from disease such as Alzheimer's, Parkinson's or even stroke, and avert age-related decline. Thus, playing digital game could lead to exercising can bring benefits to the older people.

On the other hand, the touchscreen-based platform also offers a natural user interface where the mouse or keyboard was replaced by the touchscreen ability. Here, the participants only need to perform a simple movement such as *tap*, *zoom-in*, *zoom-out* and *tilt-left* and *tilt-right* when using the touchscreen platform.

4 out of 10 focus group participants prefer to play games using console compared to 6 participants choosing the tablet. All of the male participants prefer using a tablet rather than console. The reason for such preference was because the majority of the male participants were within the age range of 61 to 75, where 2 out of 5 participants asserted age-related declines as a main issue for them. Specifically, the main issue was experiencing a poor hand-to-eye coordination. Meanwhile, the other two male participants further remark that they

want to play games on a portable device so they can play it instantly. Several reasons were given by the male participants as follows:

> *Hand-eye coordination and all is not my game. I prefer for the first one (tablet). The challenge thing (games). (F1, R)*

> *But that game* (on tablet) *I could imagine playing that game, anytime, anywhere (F3, V)*

> *I'd say the tablet more convenient, it is more instant. (F5, C)*

Only one female participant chose a tablet over the console, having the reason that she has a total control (touchscreen) when using a tablet and the portability reason (can play anywhere and anytime).

> *I prefer the iPad because I have more control over it. This is more for me because it's something that I really am aware of – how to use an iPad and how to do that. I would prefer to be in my bed and be able to sort of play on my iPad. (F5, S)*

The reverse pattern was observed among female participants, where four out of 5 female participants prefer playing games with the console-based platform. The main reason stated were that they were having fun (during the gameplay), as well as able to interact and socialise with other people (friends, family). Besides that, most of the female participants like the idea of '*playing and exercising*' at the same time. The majority of them (female participants) found that to perform steps or answer the questions during gameplay, it requires body movement which could lead to exercise, train and stimulate the brain. Below were responses from female participants on their views towards console platform.

> *I think I like this kind of thing (Kinect) because in a way indirectly it makes my body moves. (F2, T)*

> *Because it makes you move. I mean I've got Parkinson's which is a movement disorder basically, so it's good practice and it makes me laugh. (F3, J)*

> *All the games were great, but I prefer the physical. You're exercising, you're actually exercising. Your brain has to look at the screen and acknowledge the actual lorries are coming in different directions and the colours and negotiate where your arms are being placed. (F5, G)*

However, based on the survey findings, only 46 out of 82 respondents answered the questions regarding 'what platform they prefer the most when playing digital games'. About 32.6% respondents prefer to play games using tablet followed by laptop (30.4%) and only 4.4% preferred console platforms (Xbox, PS, Wii). This finding is contradicting with the focus group findings, where the mobile type of platforms such as tablet and laptop were the most preferred platform by the respondents compared to the console platform. The main reason for this finding was because both tablet and laptop were portable and most respondents own or having easy access to it (accessibility issue). Besides that, the finding shows that most of the respondents who opted on mobile platforms were the younger respondents; those who are within the age of 55 to 65 years old. Those who were in this age group were still employed full time or part time and currently still dealing with technology to perform their tasks (refer **Chapter 2, Section 2.2.2**). Also, some of them were just recently retired with a stable disposable income.

6.4.2 Social Interaction: Gesture-based and Touchscreen-based Platforms

Mirrored the finding from Phase 1, both in the survey and focus group of Phase 2 showed that the participants commonly play the digital games at home; alone or as a single player (rather than multiplayer). In the finding of the survey, a total of 43 respondents (74.1%) were favoured playing games at home compared to only 15 respondents (25.8%) who played at other places such as at friend's house, workplace, on public transport and while waiting for people or public transport. In relation to the responses to the question of playing alone or with other people, 37 respondents (80.4%) remarked that they normally played games alone. A further six respondents (13%) responds with 'sometimes playing with another player' and only three respondents (6.5%) responds with 'always playing with another player'.

Table 6.5 Survey responses on gameplay mode (Single Versus Multiplayer)

Quote
Single Mode *'Only play at home by myself'* *'I only play games for myself… I prefer doing it alone'* *'The games I played were designed for one-man use'* *'Really not interested in playing with anyone else. It's a personal challenge'* *'The games I play are mostly only for single player - occasionally play others but as only infrequently I just play against machine'* *'I do not play challenge others type games'* *'I play against me and do not bother with ways of getting bonus scores'*
Multiplayer Mode *'I play with friends in other countries'* *'Play solo games but sometimes am the other half with my granddaughter on her PS3'* *'Sometimes with others in order to teach me more tactics in the game when necessary'* *'Sometimes play with my grandson'*

The focus groups finding, however, shows the majority of the participants (9 out of 10) prefer to play games at home. More than half of participants (6 out of 10) favours playing games alone, followed by only two participants who liked to play both mode (single and multiplayer) and another two participants likes to play games with other players. The given the responses from the participants were as follows:

Table 6.6 Responses from focus groups' participants on gameplay mode

Quote
<u>Single Mode</u> *'I think I naturally go for single player game because of the way I said that I would use the things…' (F1, R)* *'Now I played the computer. So I prefer to do it alone. It's gonna be something I can win and sometime I couldn't. Get me away from the boredom of the seriousness.' (F2, C)* *'…with a game like Solitaire or Freecell and things like that, it's much better I find to play them on my own really because you have to concentrate on what you're doing. You don't really want the distraction of other people making noises' (F3, V)* *'I play on my own most of the time and on the train and in the bed, that would be more ideal for me'(F4, S)* *'With me, I'd be going more for the games because I don't think the conditions are there for me to find another group of players very often to join in with, so therefore it would be ones that just sort of challenge the brain' (F5, C)*
<u>Multiplayer Mode</u> *'It depends on the situation. My mood. If I want to be alone, or I want to focus to something... then I would do it single player. But if I rather to be outgoing… then I will have a game multiplayer game. Then I can enjoy it with others' (F1, S)* *'For me with friends. At home I will not play solitaire or whatever games but I prefer to read, send text of check my facebook when I have the free time. But to play games...I would like to play with friends because I like to compete' (F2, T)* *'Multiplayer, yes. I like to play games with other people, but I live on my own so I can't imagine myself sitting at home on my own looking at a screen' (F3, J)* *'With other people. Everyone's like participating, aren't they, they're sort of shouting out' (F5, G)*

Although the findings from both survey and focus groups showed that the digital games were often played alone, the participants also asserted that they would prefer to play games with someone they knew (i.e. family or friends) which was similar to the finding by Jansz and Martens (2005). The reason was that the game environment can allow active interaction among family members or friends in a new and interesting way that encourages connectedness and teamwork. Responses from the participants addressing this finding as follows:

> *'But I thought, if this kind of game is used as a tool to socialise with others... then it would be... If I do it at home, alone... I won't do that usually. But to make friends or to enjoy time with friends, talking with this... it's good I think' (F1, S)*

> *'I use games to communicate with my grandchildren. If I'm staying there – for any lengthy time. Way we communicate. Because otherwise, they are always on their phones. We communicate in family games, i.e. a Wii, Kinect' (F2, C)*

> *'Yeah I think if I see other people playing games that you can join in with I wouldn't mind joining in. It could be great fun at Christmas… That's right, when our family get together at Christmas after we've feasted and all the rest of it that's what we do, we sit there and play games. Some of it's more enjoyable really than if you're in your house playing on your own' (F3, V)*

> *'Occasionally when there's a lot more people and also if I got used to that more [Xbox], I think I could enjoy it more because it's like actually using your arms and legs but it's just not knowing where to start it from by using your hands and this and that. I think when you're in family gatherings you don't know what to do sometimes, you run out of conversation and this can be quite fun when you're playing games, and then you move on to the next room and talk to somebody and somebody else is playing and you're watching them' (F4, S)*

> *'Yes, even if it's not direct there can be some social... I'd say if you're able to see or hear other people doing the same thing, even if you're not competing with them at the same time, you can go along and see how they're doing and how you doing' (F5, C)*

6.5 Context Quadrant: Challenges associated with age-related declines

Earlier in **Chapter 2**, research studies recently have shown that keeping an active brain is a good way to help memory impairment and dementia later in life (Time 2012, Time 2013), just as much as physical exercise can keep the heart and body health (NIH 2016). Reflected from Phase 1 findings, participants preferred games that can train and stimulate the brain. At the same time game that requires body/physical movement could be a bonus which also could lead to exercising. Thus, games, as explained in **Section 6.3**, were selected. All of the mini-games played were quite entertaining, and even fun to play, especially in a group, to test everyone's mathematical skills, reflexes, and also memory skills.

Moreover, both console and tablet platforms were chosen due to continuation from Phase 1 finding and both platforms offer natural interaction (body movement and touch-based interaction). Similarly to Phase 1, user interactions and experiences on digital games were further investigated in Phase 2. The addition of the advantages and disadvantages of both platforms which have been discussed in **Chapter 5, Section 5.5.3.2** were also further discussed in this chapter.

One participant, P2F5 mentioned that tablet was more flexible in the setup which was more straightforward by only 'switch on and ready to play' while console requires a set of technical skills to set-up, before playing the game. Albeit, for older people, gameplay using console offers an interesting and fun way of playing due to the big screen display. However, having big screen would require larger space and it is not portable. This issue has been a major concern most of the participants and becomes the drawback of the console platform when compared to a tablet, which was more portable and accessible.

> *To set up, it's more flexible as well. It's got that advantage but what you can do on the bigger one is, it gives you a possibility of a lot more fun, a bit more variety. Somebody might have the same thing on the tablet but then you'd have to...you know, some of those you could do it on the big screen but some of those it's just not enough room there to put enough alternatives around there to really challenge your mind but still be able to see.(*F5, C)

While another participant, P1F1 added, the type of floor should also be considered when playing the game using the console at home. This could prevent the older people from falling while playing.

You have a point there. In fact it much be worst because you're playing at home, the type of floor that you have. (F1, R)

6.6 Discussion on the Key Highlights

Based on the findings from Phase 1 and Phase 2, there were three main components that could be highlighted:

i. Perceive difficulties/insecurity when playing digital games,
ii. Perceive benefits from playing digital games, and
iii. The Importance of the Social part of Interaction.

These components were closely correlated with the four quadrants, *user, context, representation* and *theory*. Discussions on each key highlight are discussed in the following subsections.

6.6.1 Perceive difficulties/insecurity when Playing Digital Games

Based on the *User* quadrant, one of the key elements that need to be considered is the feeling of insecurity in terms of the perceive difficulties. Findings show that the participants perceived the technology as difficult. However, when the participants were put in a social setting/context, the social interaction is deemed as very important for this group of people.

Most participants were retired and due to their 'insecurity', they prefer to play games at home as a single player or sometimes with their family members (their grandchildren) or friends whom they knew. Thus, this is something to be considered by the game designer; to create games that allow older people to play along, for example, playing with their grandchildren as the majority of them do not like to play games with strangers.

Moreover, perceive difficulties could be removed when older people playing in a social setting/context with strangers (social interaction). Discovering some real-life benefits to the game-play (social interaction) could change their perception/perspective towards digital games.

6.6.1.1 Context Quadrant

With regards to the link between the *User* quadrant's findings and the issue of 'insecurity and perceiving difficulties', one key element that needs to be considered is the *Context* of the games itself. One of the key things was to consider the C*ontext* of the game itself. Games that support social interactions is important because the majority of the participants addressed that they prefer to play games if it is in a social context/setting, such as playing with grandchildren or friends, or to do it at home either playing alone or with someone they know (friends or family). Several studies show that older people like to play games with their family members and friends (Khoo *et al.* 2006, Voida & Greenberg 2009) which were believed to be a catalyst for encouraging social interaction and reducing the digital divide among the intergeneration. Based on the findings, participants were also comfortable playing with strangers when put in a social context, due to the reason they could observe how other people are playing and they learn from their observation.

6.6.1.2 Representation Quadrant

Linking to the *User* findings, 32.6% participants (from the survey) and 60% of the participants from the focus group (in Phase 2) prefer playing games using a tablet. This mirrored the results as in Phase 1, where most of the participants prefer console at the beginning, particularly during gameplay session. However, due to the drawbacks of the console (refer **Chapter 5, Section 5.5.3.2**) for example, the age-related declines problems (age group 61-75) – hand-eye coordination, require technical skills in setup the platform and required suitable environment (i.e. spacious space, floor condition). Therefore, the participants opted to tablet platform due to its portability, accessible (most participants already owned it) and its cost effectiveness.

Finding from **Section 6.6.1** shows that the social interaction was used to gain confidence where the social interaction was one of the criteria fall under *Representation*. Besides social interaction (interaction between participants), there were two other types of interaction which were important and highlighted in this study, namely interaction with the device and interaction through the game (interpersonal).

Findings from both phases show that the participants like to have control ('*autonomy'*) on what they were doing. Taking control was important and this finding (*representation*) linked

to the finding of the type of *user* especially when the participants perceive difficulties due to not in control when playing games. However, once they were in control, their perspectives towards digital games changed and they were willing to take part in the gameplay (to join their friends). This can be seen in a situation where the participants perceived difficulties when they were not in control (i.e. cannot choose the answer due to the sensitivity of touchscreen or slow response from Kinect sensor). However, when they were in control, they changed their perspective towards digital games; from reluctant to take part into willing to take part in gameplay during the focus group.

6.6.2 Perceive Benefits from Playing Digital Games

Similar to the finding from Phase 1, participants' perspectives on the perceived difficulties and benefits of digital gaming were influenced by their confidence barriers related to their first impression, their perception of engaging with something new (i.e. technology) and their perspective towards the relevance of technology.

6.6.2.1 Something New or Beneficial

Reflected from Phase 1, the survey respondents and focus group participants reported to prefer and own a mobile platform such as tablet and laptop. This is due to the mobile platform is portable and affordable. Several participants stated an interest in playing games on the device after participating in the study.

One participant, F3P1, (who has Parkinson's) was having fun playing games on both platforms. The participant found it was interesting to play games that require physical movement which she asserted as fun and helped her to exercise. Thus, she indicated the cost and benefits of the games were important especially to those who have age-related problems.

> *'... it's cost benefit and you have to analyse the cost of the benefit. If they said it's specifically good for Parkinson's then I might think about it. Because it makes you move. I mean I've got Parkinson's which is a movement disorder basically, so it's good practice and it makes me laugh. I might be able to compare performance between one day and the next'*

By taking this example, it shows that the participant obtained new knowledge and learning new thing. It also brings benefit to them (i.e. participant who has 'hand tremor', Parkinson's). Furthermore, it encourages the participants to engage more with the technology and increase positive perception (linking to the **Section 6.6.1**) when playing digital games

6.6.3 The Importance of the Social Part of Interaction

Correlating to the finding in *User* and *Representation quadrants*, even though participants perceive difficulties when using game technology, their perspectives (through own interaction and experience using digital games) are changing when they were interacting through social interaction. Social interaction was the key aspect of the game design that should be considered. According to the interaction levels, participants can interact with different levels of interaction which are i) Interaction between participants (social interaction), ii) Interaction with the device and iii) Interaction through the game (interpersonal).

6.6.4 Theory Quadrant

Based on **Andragogy perspectives**, it has been reflected in this study (Phase 1 and Phase 2) the 'autonomy' criterion was important. It shows the degree of freedom where the older people have total control of the game itself. If they were not in control, they will feel uncomfortable and easily get frustrated in (linked to the first finding, **Section 6.6.1**). This will be directly proportional to the andragogical perspective - the older people's need to take control over their learning (i.e. utilising the platform) and enthusiasm towards learning activities that they are participating in (i.e. playing games).

The findings from both phases also show that the older people were more interested in learning or participating in an activity that has immediate relevance to them (work or personal life). This can be related to learning something new or something that brings benefit to them (**Section 6.6.2).** On the other hand, social interaction was proven to be a catalyst in reducing the digital divide among the intergeneration (grandparents and grandchildren). This could encourage togetherness and teamwork. Although the findings show a large number of

participants like to play the game alone or in single player mode, they do sometimes prefer to play games with someone they knew (i.e. family or friends).

6.7 Summary

This chapter outlined the overall findings from the survey and focus group setting that has been conducted. Detailed results and analysis of the data are also discussed in this chapter. The discussion was based on the further investigation and validation study that reflected the preliminary study (presented in Chapter 5). The findings and outcomes of this analysis; *perceive difficulties/insecurity when playing digital games, perceive benefits from playing digital games and the importance of the social part of interaction* helps to validate and answer research questions. Also, these findings enable the fulfilment of the research objectives aimed by this thesis. The next chapter highlights the key findings of both phases in this research study. These highlights are meant to discuss the crucial findings that were obtained through the activities in this research study.

CHAPTER 7

DISCUSSION AND CONCLUSION

7.1 Introduction

The primary main aim of this research is **to investigate the user interaction and experience with digital games using the console and mobile platforms, with the target group of older people between the age of 55 to 75**.

To achieve this aim, research questions were developed and studies were formulated. This research has contributed to knowledge through the investigation into user's interaction and experience with digital games on console and mobile platforms for older people (age 55 – 75). The user interaction consists of; interaction with the platforms (console and mobile), interaction through the game and interaction between players. The user experience represents the perception and response that result from interactions between players, platforms, and events (during in-game). This investigation also can be seen as a stepping stone to provide guidelines for designing the digital game to the targeted group. In achieving this objective, andragogical perspectives and challenges associated with older people are taken into consideration. These considerations are important since the older people have needs, preferences and health restrictions that are different from the other age groups, namely children, adolescent and young adults.

The input from participants are used to obtain the game attributes and design considerations. Concurrent mixed methods using triangulation design was applied for data collection and analysis. The participants provided the quantitative and qualitative feedback through survey, gameplay and group discussion; offering their perceptions (user interaction and user experience) towards the digital games. This study is significant as it has identified areas for further understanding and development of digital games targeting older people.

Therefore, this final chapter provides the overall summary and the conclusion of all other discussed chapters (**Chapter 1, 2, 3, 4, 5** and **6**). The contributions and limitations of this study will also be discussed. Brief discussions on several potential future works are also presented at the end of this chapter.

7.2 Summary of Results

The world population is ageing and the life expectancy of older people gradually increased. In 2020, the number of older people (aged 60 and above) is forecasted to outnumber children younger than 5 years old. By 2050, one in five people in the world will be 60 years of age or older (Akitunde 2012). This ageing population is growing faster than any other age group, predicted to reach 2 billion by 2050 (Aalbers *et al.* 2011, WHO 2002). With ageing, older person inevitably encounters and suffers various age-related changes, such as cognitive, psychosocial, cognitive and motor skills. Thus, technology such as digital game could help and encourages older people to exercise physically and mentally. This will helps to delay the occurrence of diseases and to improve their quality of life (Bolton 2010, Roger and Mynatt 2003, Czaja and Lee 2009, Nap *et al.* 2009). As mentioned in **Chapter 2**, the currently available games are mostly targeting children and young people, without considering the older people needs, preferences and restrictions. Based on andragogical perspectives, older people have a different lifestyle, needs, interests, and physical attributes compared to other age groups. However, the growth in adoption of digital games by older people is promising. Therefore, this research study focuses on the older people needs and preferences towards digital game's usage. It is essential that older people to be captivated and engaged by the game before any serious purposes can be imposed. For this purpose, a guideline for developing a suitable game for older people is presented. Key findings are presented in the following subsections.

7.2.1 Interpersonal and Social Needs

In the context of the age, this research found that the digital games are not primarily played by the children and adolescent. In fact, older people also played digital games even though the exact number of older gamers is not available. As mentioned earlier in **Chapter 2,** 70% of the gamers over 45 years old were the biggest consumers of mobile games (Gaudiosi 2011). Moreover, Figure 7.1 shows the age distribution of mobile games found in their research survey with 14% of mobile gamers were the younger gamer (16-24). While the 25-34 age group spend the most time playing games, and nearly a third were older than 45 years old.

Figure 7.1 Age distribution of mobile games (Gaudiosi 2011)

Gaudiosi (2011) also revealed a direct correlation between gamer's age and the amount of money spent on virtual goods within social games. Correspond to this finding; this research observed that the older the gamer's age, the more they spend. This was due to the older demographics have more disposable income and their willingness to spend money to progress further to save time or when they can perceive benefits from playing games (i.e. social aspects, train and stimulate brain).

Based on the findings, there were various reasons for playing games among older people. It is not limited to the brain stimulator games, leisure and killing time but also for socialisation. De Schutter (2011) and Pearce (2009) found that the older people gaming needs and preferences were different from the youngster. Research by Shen (2014) revealed that digital game such as massively multiplayer online role-playing games (MMORPG) was appealing to different age groups for different reasons. This was due to the inherent complexity and the multitude of activities available in this gaming world, hence the different social circumstances of people at different age groups. Other studies (Yee 2006, Williams *et al.* 2009) found that male gamers tend to score higher in all the achievement components in game compare to female gamers. However, female gamers were more motivated by the social aspect or creating a relationship in MMORPG. Similarly, this research found that the older female participants and female survey respondents were more interested in the social interaction aspect of the digital game. As mentioned in **Chapter 2**, social interaction is one of the important aspects of older people's wellbeing which could improve their quality of life. Thus, it is predicted that the participants were attracted to digital game mainly because of the

social interaction aspect offered by the game. Correspond to this finding; this research also observed that the older the gamer's age, the more they spend. This was due to the older demographics have more disposable income and their willingness to spend money to progress further to save time or when they can perceive benefits from playing games (i.e. social aspects, train and stimulate brain).

7.2.2 Sense of Control

"If you can design the interface of a system or a product in such a way that the user feels in control of the user situation, the product can reduce stress!" (Nilsen 2005).

There are three important components needed in creating a game design successfully, namely sense of control, the opportunity for a strategy and discovery of information (Neal 1990). Control is a major factor in the gaming experience. A successful game could offer a good sense of control to the player in terms of their interaction with the game, platform and other players. With regards to the andragogical perspective, the literature review chapter shows that several researchers reported that the older people have different needs and preferences when it comes to playing digital games as compared to children and adolescent. Knowles *et al.* (2014) stated that the older people need to see the benefits of learning, have the 'autonomy' during learning, have a contextual orientation towards learning and the benefits from experiential learning.

In both phases (Phase 1 and Phase 2), this research found that the participants like to be in control ('to be autonomous') on what they were doing; in this case when playing digital games. Taking control was an important element and this finding (representation) is linked to the finding of the type of user, especially when the participants perceive difficulties due having a sense of control when playing games. Researchers revealed that the older people should feel that they achieved some form of accomplishment during gameplay. Otherwise, they will feel demotivated to continue playing. Participants used the words such as "easy to use" and "able to adjust/control" to reveal their experience of feeling in control when playing the game. This can be observed when the participants were able to make a connection between their actions and responses on the screen (interaction with equipment). Hence, perceive difficulties within participants can be removed when the older people enthusiasm towards learning activities they are participating in (i.e. playing games). For example,

participants feel that their sense of control is increased as the game progressed, where initially the game was perceived as difficult. As the players practice more and continue to play the game, their skills and involvement with the game are also increased. Lack of control occurred when one player was beaten or cannot compete with the opponent.

7.2.3 Gesture-based and Touchscreen-based Interactions

Interaction with the equipment is one of the three main interactions highlighted in this research study besides interaction with other people (social interaction) and interaction through the game (interpersonal). Based on the finding found in **Chapter 5** (**Section 5.7.3)**, it shows a statistically significant difference between console and tablet for two items; Player Enjoy Playing the Game ($p = 0.008$), Player in Total Control ($p = 0.033$). Thus, this result revealed that when the older people were in a total control of utilising the platform, they found enjoyment and engagement in playing the game.

With regards to *Representation* quadrant, the participants in both phases describe that the use of the gesture-based and touchscreen-based interactions was interesting yet restrained. Also, gesture-based and touchscreen-based platforms provide a degree of freedom and autonomy. By using a gesture-based platform, it offers a natural user interface where the participants were able to move their body to exercise their brain without holding certain devices (i.e. controller). This can be observed when the players performed the tasks by following the instructions that were displayed on the screen. Also, this observation is clearly seen during the gameplay session, where the action of swaying the arms from side to side, to swing an oscillating needle to the correct answer and lifting their feet to kick the soccer ball to the correct answer. On the other hand, the touchscreen-based platform also offers a natural user interface where the touchscreen ability replaced the mouse or keyboard. Hence, the participants only need to perform a simple movement such as *tap, zoom-in, zoom-out* and *tilt-left* and *tilt-right* when using the touchscreen platform.

There were several considerations when choosing a right platform to design a game for older people. These considerations are the health reason (i.e. poor hand-eye coordination, tremor hand), portability and accessibility as well as the weight and the price of the platform. Based on the finding, 80 out of 82 (97.6%) survey respondents reported that the cost of the platform plays an important role when considering which platform to buy. Therefore, they prefer to

play games on mobile devices such as on tablet or laptop. The main reason for this finding was both tablet and laptop were portable and most respondents own or having easy access to it (accessibility issue). Moreover, the familiarity with the mobile devices can bring ease of use to the users. The finding shows that most of the respondents who opted on mobile platforms were the younger respondents; where the age is between 55 to 65 years old. Those who were in this age group were still employed full time or part time and currently still dealing with technology daily to perform their tasks. Also, some of them were just recently retired with a stable disposable income.

7.2.4 Gameplay Interaction and Challenges Associated with Age-related Changes

As discussed in **Chapter 2**, to capture the adequate interaction between players and the games, the aspects of user experiences, together with their needs and interests should be considered and examined. Thus, in this research, feedback from the participant's interaction and experiences were taken into consideration. Normally, older people will go through countless changes in different levels such as changes at the perceptual, cognitive and psychosocial (Kaufman *et al.* 2014). When it comes to challenges usually faced by older people, it is associated with age-related changes.

Similar to findings by Whitcomb (1990), Ijsselsteijn *et al.* (2007) and Flores (2008), this research also found that the age-related declines such as physical and cognitive functions could influence gameplay (i.e. preferences) for older people. Apart from that, from the findings and feedbacks of interaction and experience of older people, eight considerations are taken into account. The considerations are as follows:

i. A simple, relevant information and clear instructions are important (i.e. text, auditory) and should be included in the game especially for older people. Poor eyesight and hearing problem are among the reason why this consideration is very critical in designing games for older people. Thus, text on the screen and audio of narrator could help and ease the gameplay,
ii. A simple and less element in interface design was preferable. This is to prevent confusion (perceive difficulties) to the older people with unimportant and unwanted buttons and applications on the screen. This will indirectly require less working memory,

iii. The degree of freedom and total control in adjusting the platforms used such as font type, size, volume and screen resolution. This could be helpful for those who have eyes sight and hearing problems. Also, the older people prefer to have a flexible in setting up the platform for the digital game. Therefore, something that requires technical skills to setup should be prevented as the older people preferred something straightforward by only *'switch on and ready to play'* platform. Based on the findings, it also shows that the older people prefer to have control over what they do. This is associated with andragogical perspectives where the older people are an independent self-concept and who can direct/control his or her learning (Knowles 1984),

iv. No time limit/timer included in the digital games for older people. The reason is that "some people take a longer time to learn things than others". Thus, with no timer option, the gameplay will require less strength and be more appealing to the older people,

v. Less strength and memorisation needed when playing games. The design of the digital games should consider avoiding the usage of input devices (i.e. controller) and promotes natural body movement (i.e. physical game) as the replacement,

vi. Typing can be replaced by voice recognition, while touch screens can be helpful when the 'older gamers' are having difficulty with wrist/elbow movement that is required when using a mouse. The natural interaction offers in console become the main attraction to the participants,

vii. A selection of size and the lightweight platform is important. Size and weight of the tablet would affect those people who have joint pain (i.e. arthritis). Therefore, a selection of size and the lightweight platform is important in this research so that it will not bring any effects to the participants. Hence, the games developed should require less strength to be played, and

viii. Cognitive and physical types of games are found to be suitable for older people within this target group. Social interaction is an important attribute that needs to be included in the game, particularly for older people. Thus, interaction is needed in designing a game for older people to promote active social interaction. Confidence barrier such as afraid of taking part when it involves new technology is among the challenges that caused the older people to be not interested in technology besides of no self-confidence (i.e. interact, try new thing, involve in activities). Therefore, interaction is needed to ensure the older people can be more confident when interacting with others as well as with the technology (especially digital games). While participating in a

game play, participants were encouraged to work with others (team-based) where working collaboratively can stabilise strategies more rapidly than playing as a single player. Besides that, the participants will find that it is more fun and more challenging as well as motivating when playing the game collaboratively.

7.3 Study Contributions

As mentioned in **Chapter 2**, there were a number of studies done on designing and developing digital games focused on older people. Besides that, the studies were mostly based on pedagogical perspectives. In the literature, there is no research found addressed digital games for the use of older people correlate the attributes of game technology with considerations, such as andragogical perspectives (how adult people learn) and challenges associated with the target group.

In creating a game design specifically for older people, there are several considerations that need to be considered, especially with regards to the interaction and experience. This research study found and listed guidance based on the four main quadrants, namely user, context, representation and theory. Based on the four key findings and synthesised mentioned in the previous sections, this research manages to propose two main contributions which are as follows:

(a) Process of obtaining the guideline

This research addressed the method to work with the older people where the researcher, academic and designer can refer. A mixed method approach was utilised to improve the effectiveness of data collection (a combination of qualitative and quantitative methods) as well as to obtain information from different angles and perspectives. Also, this research correlates the attributes of game technology with considerations, such as andragogical perspectives and challenges associated with the age-related declines. The correlation presented in this thesis distinguishes this research with other existing researches. The reason for such method to be proposed is because previous research mostly conducts their focus groups on generic audiences such as children, adolescent and young adult. Lack of explanation on how the data collected in the research is also accounted. Thus, in order to conduct a particular experiment for older people, a proper research design is needed. **Figure**

7.2 illustrates the summary of the research design flowchart proposed by this research study. Refer **Chapter 4, Section 4.1** for overall research design and further explanation.

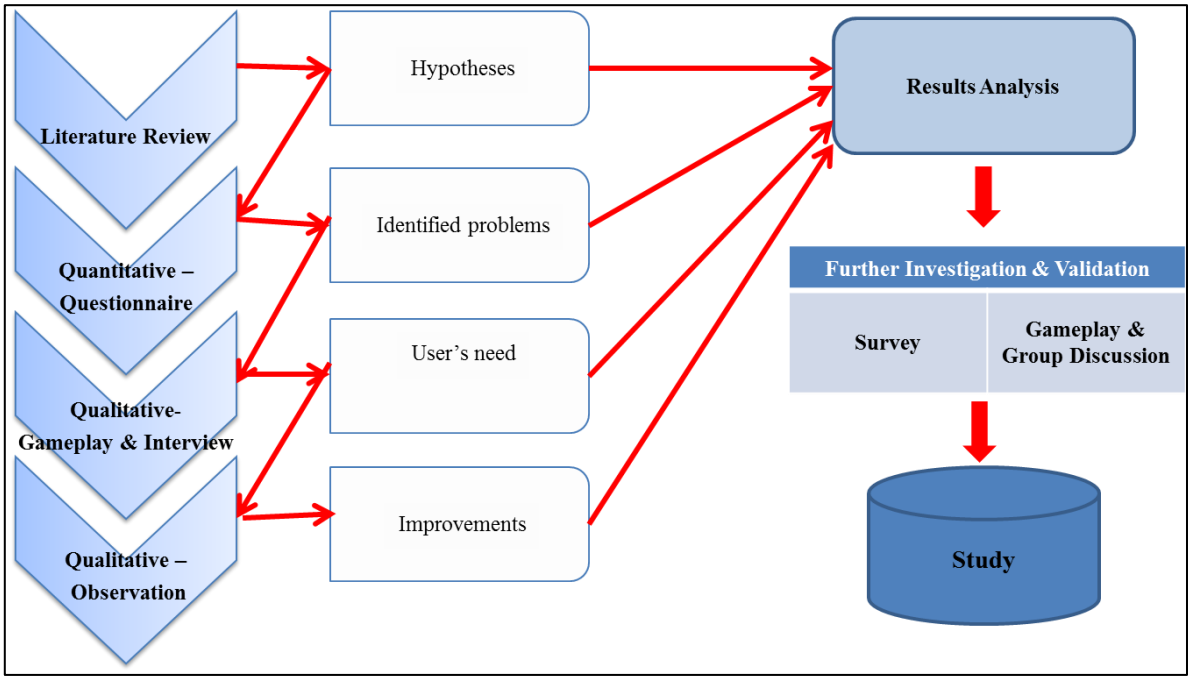


Figure 7.2 Summary of the Research Design Flowchart

The introduction of the focus group in this research is the crux in the design phase. Refer **Figure 4.2** (**Chapter 4, Section 4.6.4**). It brings benefit in obtaining feedback and gaining an understanding of the older people perception (i.e. interaction and experience) and needs towards the digital game. Several methods were applied in two different phases of the research study. The most important methods used were questionnaire/survey, gameplay, observation and group discussion. Questionnaire/survey was used to obtain participant's demographics background along with gaining their understanding of the digital games. In gameplay session, participants were asked to play several games. Prior to the gameplay session, explanation on what they need to do (i.e. giving clear instruction on how to play) and how to control the game using different platforms (i.e. console and tablet, body gesture and touch-based) were given. This is to highlight the knowledge contribution in terms of the way researcher may conduct an experiment, particularly when it involved the older people.

(b) Design Considerations

Another main contribution of this research is to propose a guideline that can be referred by the other researchers, game designers or academician to design and develop a digital game focusing on older people. The guideline (see **Section 7.2**) is derived from the integration of:

i) The four quadrants (user, context, representation, theory) which were synthesised from existing frameworks (MDA, 4DF, RETAIN and ADGBL), and

ii) The two studies conducted (Phase 1 and Phase 2). The key findings from these two phases are the older people's direct interactions and experiences with digital game technologies, specifically based on gesture and touch-based platforms.

Also, this guideline is developed specifically for the use of developing games for older people that correlates with the andragogy-driven and challenges faced by this target group.

7.4 Study Limitations

Throughout the research study, there were several issues that were encountered. The issues are listed as follows:

(a) Difficulty in recruiting the target group

At the very beginning, there is a problem in recruiting the target group. This is due to the mean of recruitment was only by sending out formal invitation email to several older people groups within the Coventry University. Only a few participants responded to the email and the total number of participants was not adequate to conduct focus groups. Thus, drastic approaches were taken in order to recruit and attract more participants from the older people population. Besides formal invitation email to the older people groups at Coventry University, the invitation was also sent to several other forums, groups and organisations such as AgeUK (refer **Table 4.2** in **Chapter 4**). The invitation was also extended to personal emails, which the receivers were among the older people. These people were recommended and suggested by their family member, friends and acquaintances from the same group, forum or organisation. For both focus groups and survey recruitment, social medias such as Facebook, Twitter and online forums were also used to connect and to reach the target groups. Permission from the web (online forums, organisations) and group's administrator was requested prior to the posting of the advertisement.

Due to perseverance and patience throughout this investigation, researcher managed to recruit 14 participants for the focus group in Phase 1. Meanwhile, in Phase 2, 100 respondents responded to the survey along with 10 participants took part in the focus group. Refer **Chapter 4**.

(b) Sample size of target group

The sample size of participants in Phase 1 is considerably smaller than Phase 2. This is due to the recruit methods used at the beginning of the studies. In Phase 2 there were more than 30 participants were interested in taking part in the focus group; recruited from the previous study (Phase 1) and survey. However, only 10 participants participated in Phase 2 (as opposed to 14 in Phase 1). As previously described, this was due to the limitations of a focus group study (only for those who live in Coventry), the timing of several participants is not matching, and unanticipated participants withdraw from this research (due to health problem). As a result, the collected feedbacks and findings in Phase 2 was comparatively smaller than Phase 1. In order to reach statistical significance for some of these effect sizes, larger samples may be required. Thus, the findings in Phase 2 were back-upped and enriched by the findings from the survey (100 respondents) that conducted at the early stage of Phase 2. Having to say this, the concurrent mixed methods design using triangulation design is the suitable method used in research study.

7.5 Areas of Future Research

Given the study's limitations, the implications of the study should be viewed as recommendations for future research. Ideas for future work derive from the methodological limitations. Further research is to conduct a large-scale sample to better understanding and further justifying the findings found in this research. Large samples and multiple sources of respondents are believed to be able to enrich the rigour of the empirical evaluation (Campion *et al.* 1993). Therefore, it will be interesting to conduct the research and compare the results with other countries such as Malaysia. It also can be seen as a solution to overcome the issue in the recruitment process.

Besides that, conducting research outside of the United Kingdom could help to obtain different and interesting data which could not be found in the United Kingdom due to the demographics disparities. For example, based on the participants' education level, it would be interesting to explore which age groups are playing digital games. In their studies, De Schutter (2011) and Pearce (2008) revealed that older people who partake in their studies tend to be well educated. Meanwhile, Lenhart et al. (2008) found that older people from different age groups tend to have medium to high education level. The question regarding participant's education level was not included in this research study. Therefore, in future research, the level of education could be included to obtain complete characteristics of older people.

Currently, a mixed method of research tools was used such as questionnaire/survey, observation and group discussion. The additional method namely phenomenological study can be used to gain more in-depth understanding of phenomena (experience) on how do the older people playing digital games. This method usually used to discover people experience as they are lived (Lester 1999, Waters 2016). Hence, this method is useful in exploring the lived experience of older people playing the digital game.

Another possible future research is to broaden the age range group into sub-groups such as young-old (i.e. 45-55), middle-old (i.e. 56-65) and old-old (i.e. 66-75). The reason for such categorisation is to explore and perform an in-depth comparison of each sub-group in terms of their perceptions in gameplay. This research could be done in order to prove or disprove the previous findings by (De Schutter 2011, Pearce 2008), where it is reported that older people have different gaming needs and preferences from younger people.

7.6 Summary

In conclusion, the success of this research study is highly dependent on the involvement of the target group. This research study's target group was the older people who were within the age of 55 to 75 years old.

Game design and design issues are important aspects that need to be taken into consideration in developing a suitable digital game for older people. However, older people perceptions (interaction and experience) towards digital games were the utmost component. Thus, it is essential that older people be captivated and engaged by the game before any serious

purposes can be imposed. Hence, any designer or researcher in the future who would like to design a digital game for older people should consider and understand the older people's needs, preferences and interests. The guideline developed by this study was specifically targeting older people and it could be used in the similar context of other discipline areas where older people's participation is concerned.

Apart from all the described future works, the works presented in this thesis are verified by empirical study and further verified through statistical analysis. Finally, as mentioned earlier, it will be interesting to observe the comparison between the demographic disparities between several countries (i.e. the United Kingdom and Malaysia) which focusing on the ageing population.

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APPENDIX 1

Ethics Request Updated

CU Ethics <omis@coventry.ac.uk>

Wed 30/07/2014 13:53

To:Suriati Jali <jalis@coventry.ac.uk>;

OMIS2

The following ethics request has been approved by James Shuttleworth. All the relevant documentation will be available for you to download within the next 24 hours. Please log back into Ethics and select the request from your listing. Select the Downloads tab to retrieve the documentation.

Please proceed with good ethics.

Ref:	P23324
Project Title:	A Serious Game Framework for Older People
Applicant:	Suriati Jali
Supervisor:	Sylvester Arnab
Module Code:	M03SGI
Module Leader:	Fotis Liarokapis

Go to ethics.coventry.ac.uk to view this request in more detail.

THIS MESSAGE HAS BEEN GENERATED AUTOMATICALLY - PLEASE DON'T REPLY TO THIS MESSAGE

APPENDIX 2

Participant Information Sheet

Study title:

A Serious Game Framework for Older Adults

What is the purpose of the study?

This study is being carried out by Suriati Khartini Jali, a PhD research student at the Serious Games Institute, Coventry University. The proposed of this work is to provide a serious game framework for older adults, which in turn will become the guidelines or an effective design approach that can be used when developing an innovative game-based environment that correlates the technologies and andragogy (adult learning) perspectives. It will analyse the feature or element in serious game facilities andragogical perspectives, while maintaining good gameplay for older adults. The focus will be on empirically demonstrating what features of serious game framework are crucial for motivation and learning among older adult users.

Why have I been approached?

To be of value the study requires the assistance of a large number participants, for statistical purposes, since owing to random elements and other variables, only a sufficiently large sample can be relied upon to give results to the necessary degree of confidence.

Do I have to take part?

No. Participation is entirely voluntary. If you change your mind about taking part in the study you can withdraw at any point during the sessions. This can be by a spoken request during any period of the study itself or by contacting me via email [jalis@uni.coventry.ac.uk] quoting your participant reference number. If you decide to withdraw, all of your data will be destroyed and will not be used in the study. There are no consequences to deciding that you no longer wish to participate in the study and this is seen as a normal right within such research.

The activities you will be involved in will not be outside the scope of activities you would normally be asked to participate in, in a module of this nature.

What will happen to me if I take part?

The study requires you (the participant) to complete a series of questionnaires surrounding your views of game-based learning (adult learning (andragogical) perspectives), ICT (Information communication technology) and your overall technical experience. You will then be asked to join the games demonstration or play through a series of digital Serious Games that focus on ageing population. Each play through will be monitored by the researcher, Suriati Khartini Jali, and at the start of each session an informed briefing will be given. After this exercise you will then be asked to fill out a second set of questionnaires which contain your views on the content of the game/s that you have played through.

If you consent to the audio and/or visual recorded interviews, then you will be asked a series of questions to aid in the development of a new older people game. These questions might ask about your experiences and/or suggestions surrounding ICT & older people acceptance.

What are the possible disadvantages and risks of taking part?

Some of the tasks you will be asked to perform may be challenging or repetitive and cause some emotional reactions within the normal range of reactions. This is a necessary part of the trial. It is not expected to cause any excessive distress and may be a pleasant experience. You may withdraw from the exercise at any time and the researchers may end the trial if undue distress does occur to either yourself or the other participant.

The interview stage intends to, in part, inquire about your experiences. If you feel uncomfortable or unsure how to answer, please note there is no right or wrong answer, and you can always refuse to give an answer if you wish. The interview will be audio or/and visual recorded, and you will be assigned a participant number that will be cross-referenced to the consent form for confidentiality.

If any aspect of the research causes you distress or you wish to remove yourself from the study, then you can contact the researcher directly.

What are the possible benefits of taking part?

The results of this study are intended to contribute to, and aid in, the design of further tools for game-based learning support (Serious Games) in the subject area of ageing society. By concentrating research efforts into practitioner centred design, developers can optimise techniques in ICT delivery by considering the acceptance by ageing society.

What if something goes wrong?

If there are any problems or you have any questions concerning the study at any time, please contact the researcher directly. If at any point a session needs to be postponed or cancelled then the researcher will attempt to contact you as soon as possible using the method indicated by you on the consent form.

If you change your mind about taking part in the study you can withdraw at any point during the sessions and at any time in the two months following that session by contacting the researcher using the email address or telephone number stated below.

If you decide to withdraw, all of your data will be destroyed and will not be used in the study.

Will my taking part in this study be kept confidential?

Yes. Only the principal researcher will have access to the raw data or the Director of Studies if he is unable to discharge his duties. All the consent forms will be stored in a separate, secure (locked) location from the raw data itself. Only your participant number will identify you. This will be cross-referenced to permission forms.

All participants are asked to agree to respect the privacy of other participants and not disclose such information outside of the research project.

All electronic data, including any audio or/and visual recordings, will be held in encrypted computer partitions using 256-bit AES (Accepted by the US Government as suitable for Top Secret documents). Secure passwords will be used and kept separate from the data.

All research is unconnected with your employment and your identity will be kept anonymous and restricted to within the research team.

For any wholly owned US organisation, the US authorities can obtain that data under the Patriot Act. However your real name and identity will not be available, as the files storing your names will be kept separately in a UK based filing cabinet.

What will happen to the results of the research study?

The results will be written up and presented as part of the researcher's PhD thesis. Results may also be presented at academic conferences and/or written up for publication in academic journals.

Who is organising and funding the research?

The research is organised by Suriati Khartini Jali, a PhD student at the Serious Games Institute, Coventry University. This project is not externally funded.

Who has reviewed the study?

This study has been through the University Peer Review process and been approved by the chair of the UARC/RDS-C.

Making a complaint

If you take part and are unhappy with any aspect of this research then you should contact the Principal Investigator in the first instance. If you still have concerns and wish to make a formal complaint about the research then you should write to:

Professor Ian M. Marshall
Deputy Vice Chancellor (Research)
Coventry University,
Priory Street,
Coventry,
CV1 5FB.

In your letter, please provide as much detail about the research as possible, the name of the researcher and indicate in detail the nature of your complaint.

Contact for Further Information

Principal Researcher

Suriati Khartini Jali
Email: jails@uni.coventry.ac.uk
Tel: 078 4172 9221

Director of Studies

Dr. Sylvester Arnab
Email: SArnab@cad.coventry.ac.uk
Tel: 024 7615 8201

The Consent Statement

Please sign both the Research Team and Participant Sections.

Research Team Copy

Participant Reference Code:_____

Please answer the following questions by circling your responses.

Have you read the information provided about this study?	YES	NO
Have you been able to ask questions about this study?	YES	NO
Have you been given enough information regarding this study?	YES	NO
Have you received answers to all your questions?	YES	NO
Do you understand that you have the right to withdraw from this study without needing to provide a reason?	YES	NO
Are you happy to deliver the focus group session with research staff on-hand?	YES	NO
Would you like to provide feedback in a one-to-one discussion with a researcher afterwards?	YES	NO
Do you consent to audio or/and visual recordings of the interview sessions?	YES	NO
Are you happy to participate in all aspects of the study?	YES	NO

Your signature will certify that you agree to take part in the study that you have been given information about. It will also show that you have had adequate opportunity to discuss the study with an investigator, and that all your questions have been answered to your satisfaction. Please note that this consent form will be kept by the researcher and will be stored in a locked filing cabinet away from other study data and information. Other information you provide will in no way be connected to this consent form.

I have read and understood the attached participant information sheet. By signing below I consent to participate in this study. I understand that the interview will be audio recorded and transcribed afterwards.

I understand that I have the right to withdraw from the study without giving a reason at any time during the study itself.

I understand that I also have the right to change my mind about participating in

the study until the data has been published, at least up to 2 months after the sessions have ended.

I agree to respect the privacy of other participants and not disclose any private issues that may arise outside of the research project.

Participants Signature	**Print Name**	**Date**

Participants email or phone:

Researchers Signature	**Print Name**	**Date**

Participant Copy (to be given with the participant information sheet)

Participant Reference Code: _____

I have read and understand the attached participant information sheet. By signing below I consent to participate in this study. I understand that the interview will be audio recorded and transcribed afterwards. I also understand that the study including myself will be video recorded and transcripts/video will be retained.

I understand that I have the right to withdraw from the study without giving a reason at any time during the study itself.

I understand that I also have the right to change my mind about participating in the study until the data has been published, at least up to 2 months after the sessions have ended.

I agree to respect the privacy of other participants and not disclose any private issues that may arise outside of the research project.

Participants Signature	**Print Name**	**Date**
---	---	---
Researchers Signature	**Print Name**	**Date**
---	---	---

APPENDIX 4

Participant Reference Code:_____

Thank you for taking time to complete this questionnaire. Please answer the entire question. We will keep your responses confidential.

SECTION 1: PERSONAL INFORMATION

Please fill or tick in the following information.

1. Home postcode:

2. What is your gender?

- ☐ Male
- ☐ Female

3. Which age range are you?

- ☐ 55-60
- ☐ 61-65
- ☐ 66-70
- ☐ 71-75
- ☐ Over 75

4. What is your marital status?

- ☐ Single (Never married)
- ☐ Married
- ☐ Divorced
- ☐ Widowed

5. How would you describe your employment status?

- ☐ Employment Full Time
- ☐ Employment Part Time
- ☐ Retired
- ☐ Unemployed
- ☐ Other

6. How would you describe your ethnicity?

- [ ] White British
- [ ] White other
- [ ] Indian (Asian/ British Asian)
- [ ] Bangladeshi (Asian/ British Asian)
- [ ] Pakistani (Asian/ British Asian)
- [ ] Asian other/ Asian mixed
- [ ] Caribbean (Black/ Black British)
- [ ] African (Black/ Black British)
- [ ] Black other/ Black mix
- [ ] Mixed Heritage (e.g. White and Black Caribbean)

Other (please specify) _____

SECTION 2: TECHNOLOGIES USAGE

1. How would you describe your computer skills better?

- [ ] Expert (Can perform various tasks on the computer)
- [ ] Competent (Confident to use various software such as word processor, web surfing, email)
- [ ] Novice (Web surfing, email)
- [ ] None (Never used)

2. Which of the following technologies do you personally use or own?
(Please tick **all** that apply):

- [ ] Personal computer (PC)
- [ ] Laptop
- [ ] IOS tablet (IPad)
- [ ] Window tablet (e.g. Microsoft Surface, Lenovo, Toshiba Encore, etc)
- [ ] Android tablet (e.g. Samsung Galaxy Tab, Hudl, Lenovo, etc)
- [ ] Kindle tablet (e.g Kindle Fire)
- [ ] Smart phone (e.g. IPhone, Samsung, Nokia, HTC, Sony, Blackberry, etc)
- [ ] Normal mobile phone
- [ ] None

3. From **Question 2**, what do you use the technologies for?
   (Please tick **all** that apply):

- ☐ Financial
- ☐ Travel
- ☐ News, weather, traffic information services
- ☐ Word processor / dictation
- ☐ Record information (e.g. meetings, conversations)
- ☐ Email
- ☐ Video
- ☐ Music
- ☐ Social Media (e.g. Facebook, Twitter)
- ☐ Gaming
- ☐ Shopping
- ☐ Watch TV
- ☐ GPS navigation

Other (please specify) _____

4. To what extend do you use a computer in your daily activities? (Please **circle** one)

- ☐ Yes (Every day)
- ☐ Frequently (Several times a week)
- ☐ Occasionally (Once a week to once a month)
- ☐ No (Never used)

5. Do you play games? (Yes / No)

6. What do you think about games?

_____

_____

7. Do you play any form of electronic games (e.g. PC, laptop, console, tablet, smart phone)? (Please **tick** one)

- ☐ Yes (PC)
- ☐ Yes (Laptop)
- ☐ Yes (Tablet device)
- ☐ Yes (Smartphone)
- ☐ Yes (Console device, e.g. Wii, Xbox, Playstation)
- ☐ Yes, but not listed above. (Please state) _____
- ☐ No

8. How often do you play games?

- ☐ Every day
- ☐ Several times a week
- ☐ Once a week
- ☐ A couple times a month
- ☐ Less than once a month
- ☐ I do not currently play any type of computer or digital games

9. What traditional games (non-computer based such as tennis, board game, jigsaw puzzle) you like to play?

_____

_____

10. Please circle the number that indicates how you feel towards the following aspect of game play that you enjoy.

	Never				All the time
Discovering new features or levels in the game	1	2	3	4	5
Playing with other people / socialising	1	2	3	4	5
Competing, winning, beating opponents	1	2	3	4	5
Completing challenges or quests	1	2	3	4	5

Participant Reference Code:_____

SECTION 3: USER EVALUATION OF THE INTERACTIVE GAMES

Please circle the most appropriate step on the scale from 1 to 5 for the questions below

QUESTIONS ON KINECT

PART A: SCREEN

1.	Characters on the television screen	Hard to read				Easy to read
		1	2	3	4	5
	1.1 Image of characters	Fuzzy				Sharp
		1	2	3	4	5
	1.2 Character size (font)	Barely legible				Very legible
		1	2	3	4	5
	1.3 Character type (font)	Barely legible				Very legible
		1	2	3	4	5
	1.4 Contrast with the background	Irritating				Pleasing
		1	2	3	4	5
2.	Screen size	Too small				Large
		1	2	3	4	5
3.	Screen layouts are helpful	Never				Always
		1	2	3	4	5
	3.1 Amount of information that can be displayed on screen	Inadequate				Adequate
		1	2	3	4	5
	3.2 Arrangement of information can be displayed on screen	Illogical				Logical
		1	2	3	4	5

Please write your comments about the screen here:

_____

_____

_____

_____

PART B: ICON/BUTTON

1.	Icon/button on television screen	Too small				Large
		1	2	3	4	5
	1.1 Easy to see	Never				Always
		1	2	3	4	5
	1.2 Easy to select accurately	Never				Always
		1	2	3	4	5
	1.3 Do not require much strength	Not at all				Very much
		1	2	3	4	5

Please write your comments about the icons/buttons here:

_____

_____

_____

_____

PART C: NAVIGATION

1.	Navigational ease	Difficult				Easy
		1	2	3	4	5
2.	Navigational structures (sequence of screens)	Never				Always
		1	2	3	4	5

Please write your comments about the navigation here:

_____

_____

_____

_____

PART D: INTERACTION

1. Gesture of interaction	Difficult				Easy
	1	2	3	4	5
2. Messages (feedbacks) appear on screen	Inconsistent				Consistent
	1	2	3	4	5

Please write your comments about the interaction here:

_____

_____

_____

_____

PART E: LEARNING THE SYSTEM

1. Learning to operate the Interface	Difficult				Easy
	1	2	3	4	5
1.1 Getting started	Difficult				Easy
	1	2	3	4	5
1.2 Learning advanced features	Difficult				Easy
	1	2	3	4	5
1.3 Time taken on learning to use the Interface	Too long				Just right
	1	2	3	4	5

2. Tasks can be performed in a straightforward manner	Never				Always
	1	2	3	4	5
2.1 Feedback on the completion of sequence of steps	Unclear				Clear
	1	2	3	4	5

Please write your comments about learning the system here:

_____

_____

_____

PART F: INTERFACE CAPABILITIES

1. Response time for most operations	Too slow				Fast enough
	1	2	3	4	5
2. Ease of operation depends on your level of experience	Never				Always
	1	2	3	4	5
2.1 Player can accomplish tasks knowing only a few commands	With difficulty				Easily
	1	2	3	4	5
3. Correcting your mistakes	Difficult				Easy
	1	2	3	4	5

Please write your comments about the Interface here:

_____

_____

_____

_____

PART G: MULTIMEDIA

1. Sound output	Inaudible				Audible
	1	2	3	4	5
2. Adjustable audio output	Inconsistent				Consistent
	1	2	3	4	5
3. Colours used are	Unnatural				Natural
	1	2	3	4	5

Please write your comments about the multimedia usage here:

_____

_____

_____

_____

Participant Reference Code:_____

QUESTIONS ON TABLET

PART A: SCREEN

1. Characters on the touch screen	Hard to read				Easy to read
	1	2	3	4	5
1.1 Image of characters	Fuzzy				Sharp
	1	2	3	4	5
1.2 Character size (font)	Barely legible				Very legible
	1	2	3	4	5
1.3 Character type (font)	Barely legible				Very legible
	1	2	3	4	5
1.4 Contrast with the background	Irritating				Pleasing
	1	2	3	4	5
2. Screen size	Too small				Large
	1	2	3	4	5
3. Screen layouts are helpful	Never				Always
	1	2	3	4	5
3.1 Amount of information that can be displayed on screen	Inadequate				Adequate
	1	2	3	4	5
3.2 Arrangement of information can be displayed on screen	Illogical				Logical
	1	2	3	4	5

Please write your comments about the screen here:

_____

_____

_____

_____

PART B: ICON/BUTTON

1. Icon/button on touch screen	Too small				Large
	1	2	3	4	5
1.1 Easy to see	Never				Always
	1	2	3	4	5
1.2 Easy to select accurately	Never				Always
	1	2	3	4	5
1.3 Do not require much strength	Not at all				Very much
	1	2	3	4	5

Please write your comments about the icons/buttons here:

_____

_____

_____

_____

PART C: NAVIGATION

1. Navigational ease	Difficult				Easy
	1	2	3	4	5
2. Navigational structures (sequence of screens)	Never				Always
	1	2	3	4	5

Please write your comments about the navigation here:

_____

_____

_____

_____

Participant Reference Code:_____

PART D: INTERACTION

1. Gesture of interaction	Difficult				Easy
	1	2	3	4	5
2. Messages (feedbacks) appear on screen	Inconsistent				Consistent
	1	2	3	4	5

Please write your comments about the interaction here:

_____

_____

_____

_____

PART E: LEARNING THE SYSTEM

1. Learning to operate the Interface	Difficult				Easy
	1	2	3	4	5
1.1 Getting started	Difficult				Easy
	1	2	3	4	5
1.2 Learning advanced features	Difficult				Easy
	1	2	3	4	5
1.3 Time taken on learning to use the Interface	Too long				Just right
	1	2	3	4	5
2. Tasks can be performed in a straightforward manner	Never				Always
	1	2	3	4	5
2.1 Feedback on the completion of sequence of steps	Unclear				Clear
	1	2	3	4	5

Please write your comments about learning the interface here:

_____

_____

_____

_____

PART F: INTERFACE CAPABILITIES

1. Response time for most operations	Too slow				Fast enough
	1	2	3	4	5
2. Ease of operation depends on your level of experience	Never				Always
	1	2	3	4	5
2.1 Player can accomplish tasks knowing only a few commands	With difficulty				Easily
	1	2	3	4	5
3. Correcting your mistakes	Difficult				Easy
	1	2	3	4	5

Please write your comments about the Interface here:

_____

_____

_____

_____

PART G: MULTIMEDIA

4. Sound output	Inaudible				Audible
	1	2	3	4	5
5. Adjustable audio output	Inconsistent				Consistent
	1	2	3	4	5

6. Colours used are	Unnatural				Natural
	1	2	3	4	5

Please write your comments about the multimedia usage here:

_____

_____

_____

_____

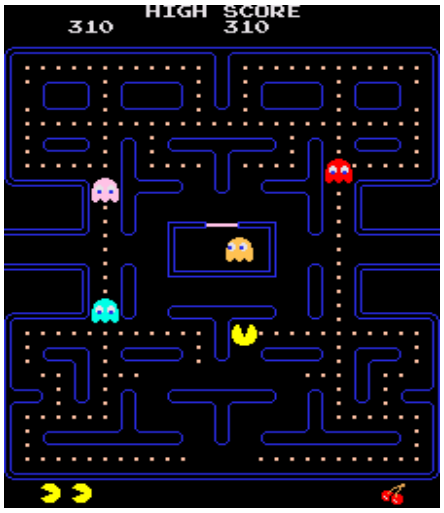
SECTION 4: OVERALL USER REACTIONS

1. Which device or platform you prefer most when playing the games?

   ☐ Tablet
   ☐ Kinect/Wii

   Please state why you choose this answer: _____

2. Game can be represented as 2-dimensional (2D) game or 3-dimensional (3D) game. A 2D game only allows movement/interaction in 2 dimensions (e.g. the original Pong game, Pac Man), while a 3D game allows movement/interaction in all three dimensions (e.g. Kinect Wii Sport Games). Game A and Game B are using a 3D game interface while Game C is a 2D game interface. Example of 2D and 3D games as follows:

	
2D game	**3D game**

   Which graphical user interface (GUI) that you prefer the most?

   ☐ 2D game
   ☐ 3D game
   ☐ Both

   Please state why you choose this answer: _____

3. How do you like to play your games?

☐	Alone
☐	With friend
☐	With stranger (online game)
☐	All of the above

Please state why you choose this answer: _____

4. Which playing aspect do you find most pleasurable?

☐Mastery	☐ Tactical Play	☐Learning New Games
☐Immersion	☐ Shared Fun	☐ Social Interaction
☐Winning	☐ Competition	☐ Attractive Components
☐Narrative	☐ Cooperation	☐ Strategic Play
☐Integrated Theme	☐ Intellectual Challenge	☐ In-Game Interaction

5. Please circle the number which **most appropriately** reflects your impression about the game's platform or device used.

Game Play using Tablet:

	Strongly Disagree				Strongly Agree
Easy to perform	1	2	3	4	5
Need assistance to perform the game	1	2	3	4	5
I enjoy playing this game	1	2	3	4	5
Playing the game was challenging	1	2	3	4	5
I did not have to wait feedback too long	1	2	3	4	5
I felt in total control of my playing actions	1	2	3	4	5
	Difficult				Easy
How would you grade the game's difficulty level?	1	2	3	4	5

Game Play using Kinect:

	Strongly Disagree				Strongly Agree
Easy to perform	1	2	3	4	5
Need assistance to perform the game	1	2	3	4	5
I enjoy playing this game	1	2	3	4	5
Playing the game was challenging	1	2	3	4	5
I did not have to wait feedback too long	1	2	3	4	5
I felt in total control of my playing actions	1	2	3	4	5
	Difficult				Easy
How would you grade the game's difficulty level?	1	2	3	4	5

6. Which **most appropriately** reflects your impression about the games? Please write a response (1 -5) that corresponds to the following scale for each statement:

Strongly Disagree - **1**; Disagree - **2**; Neutral - **3**; Agree - **4**; Strongly Agree – **5**

	KINECT		TABLET	
	GAME A	**GAME B**	**GAME C**	**GAME D**
Terrible				
Wonderful				
Frustrating				
Satisfying				
Dull				
Stimulating				
Difficult				
Easy				
Require strength				
Do not require strength				

Please write your comments about your overall reactions/impressions towards games:

_____

_____

_____

SECTION 5: OTHER REACTIONS, IMPRESSIONS OR COMMENTS

_____

_____

_____

_____

_____

- THANK YOU -

Moderator Script

Introduction

First of all, thank you for volunteering to take part in this study. My name is Suriati Khartini Jali, and I am PhD student (now in my 2nd year) at the Serious Games Institute (SGI), Coventry University.

- ✓ Imran (*Moderator B*), will be listening and taking notes at the same time will checking the equipment (audio and video recorder), and will help accordingly (game demonstration, interview session, etc)

Before we start, could you please read through the information sheet? If you have any questions regarding this research or any information provided in the document, please do not hesitate to ask.

During this session I am going to ask you to play three games on two platforms (kinect and tablet)

The whole session will take approximately about 90 minutes. I would also like you to know that you are not being tested. There is no right or wrong way of playing the games. We are testing the games themselves, and are not testing you. We are here to further our insight into which technology acceptance within older people, game design and game experience, and therefore your contribution is extremely important to us.

Do you authorise use to video record your hands as you perform a game play with kinect and gesture on the tablet? [*Wait for answer*]. The recording will help me in remembering exactly what happened during our session, as I might not have time to take all the necessary notes. The video recordings, or any other information, will not be shared with any third-parties. I will be the only person to watch the recordings.

- ✓ The focus group will be recorded and transcribed for the research team to analyse
- ✓ All transcriptions will be anonymised
- ✓ You are under no obligation to continue your participation in the focus group and you may withdraw from taking part at any time, including choosing to withdraw your data
- ✓ The focus group will be separated into the following principle sections:
    - Refer FGD Flowchart

Consent

Could you please go through the form carefully and sign it

- ✓ *Hand-out of Consent form & pen*

Please fell comfortable to interrupt the session at any moment, whether you need a break, have a question, or do not want to continue the session.

Before the session starts, do you have any questions or comments? [*Wait for questions and answer accordingly*].

Interview guide (Pre-defined Questions)

1. How did you feel during the gameplay?

2. What did you have gained after playing these games?
   - What do you like or dislike about game?
   - Did you learn from playing this game? What would it be?

3. What do you think of **playing game in pairs (multiplayer)**? What are the differences by playing as a single player and playing in pairs (multiplayer)?
   - Where do you think such game is best suited? Do you intend to play it alone at home in the living room, or in a social setting with more participants, or both?
   - If playing multiplayer game, who will you play with – friends? Family? Strangers (online game)? Give reason why you chose that answer?

4. How easy was it to learn to use the platforms? (Tablet/ Kinect)
   - Did you enjoy playing games on the tablet OR kinect?
   - Describe what are the problems that you have faced when you play computer/console/ /tablet game? (e.g. problem when using the keypad, touch screen, screen resolution, brightness and contrast, etc) – **USE COLOUR PAPERS HERE!!**
   - What bothered you the most?
   - Did the different input types result in different in-game performance?
     - Show a significant increase in time
     - Errors

5. Is there anything else you would like to add that we have not discussed as part of this focus group?

De-briefing

Before we finish, do you have any question or comment? [*Wait for participant's answer*].
I would like to thank you for taking part in our study. Your participation was extremely important to me.

As I mentioned earlier, the recordings, or any other information, will not be shared with any third-parties. Your contribution

Finally, I hope you will continue to take part in my next focus group. Till we meet again.

Thank you.

Introduction

Dear All,

You are being invited to take part in a survey entitled *'**An Investigation into User Interaction and Experience Focusing on Older Users and Digital Games**'*.

This study is being carried out by Suriati Khartini Jali [jalis@coventry.ac.uk], a PhD research student at the Serious Games Institute, Coventry University. The research aims to explore the needs and expectations of the older population and the potential of game technologies in fostering engagement with beneficial activities. This research will therefore investigate user interaction and experiences targeting older users and digital games.

The survey contains 30 questions and will take **approximately less than 30 minutes** of your time.

If you think any of the question(s) are unclear, please contact the researchers at the contact details below.

Please be assured that no participant in this research will be individually identifiable in the report or any other publications and all information gathered will be treated as confidential. We will make every effort to ensure that your responses remain anonymous.

Information that you provide will only be viewed by the principal researcher and researcher supervisor. It will be stored in a secure location and destroyed after the completion of the research study.

The results of this research will be written up and presented as part of the researcher's PhD thesis. It may also be presented at academic conferences and/or written up for publication in academic journals.

This research conforms to the ethical model used by Coventry University for medium-risk research.

By continuing to complete this survey, you are providing consent for the information to be used.

If you have any questions or concern, please contact us using either the e-mail or telephone details below.

Principal Researcher

Suriati Khartini Jali
Email: jalis@uni.coventry.ac.uk
Tel: 078 4172 9221

Director of Studies

Dr. Sylvester Arnab
Email: s.arnab@coventry.ac.uk
Tel: 024 7615 8201

Please answer all questions unless instructed otherwise. All information is confidential.

SECTION 1: PERSONAL INFORMATION

1. What is your gender?
   - ☐ Male
   - ☐ Female

2. Which age range are you?
   - ☐ 55-60
   - ☐ 61-65
   - ☐ 66-70
   - ☐ 71-75
   - ☐ Over 75

3. Name the current city of your residence: **Mandatory*

   _____

4. What is your current/previous profession?
   - ☐ Employment Full Time
   - ☐ Employment Part Time
   - ☐ Retired
   - ☐ Unemployed
   - ☐ Other

   If you selected Other, please specify _____

5. How would you describe your ethnicity?
   - ☐ White British
   - ☐ White other
   - ☐ Indian (Asian/ British Asian)
   - ☐ Bangladeshi (Asian/ British Asian)
   - ☐ Pakistani (Asian/ British Asian)
   - ☐ Asian other/ Asian mixed
   - ☐ Caribbean (Black/ Black British)
   - ☐ African (Black/ Black British)
   - ☐ Black other/ Black mix
   - ☐ Mixed Heritage (e.g. White and Black Caribbean)
   - ☐ Other

   If you selected Other, please specify _____

SECTION 2: TECHNOLOGIES USAGE

6. How would you describe your computer skills?

- [ ] Expert (Can perform various tasks on the computer)
- [ ] Competent (Confident to use various software such as word processor, web surfing, email)
- [ ] Novice (Web surfing, email)
- [ ] None (Never used)

7. Which of the following items do you personally use or own? (Please tick **ALL** that apply):

- [ ] Personal desktop computer (Desktop PC)
- [ ] Laptop
- [ ] IOS tablet (iPad)
- [ ] Window tablet (e.g. Microsoft Surface, Lenovo, Toshiba Encore, etc)
- [ ] Android tablet (e.g. Samsung Galaxy Tab, Hudl, Lenovo, etc)
- [ ] Kindle tablet (e.g Kindle Fire)
- [ ] Smart phone (e.g. iPhone, Samsung, Nokia, Microsoft Lumia, HTC, Sony, Blackberry, etc)
- [ ] Normal mobile phone
- [ ] None

8. From **Question 7**, what do you use these items for? (Please tick **ALL** that apply):

- [ ] Financial
- [ ] Travel
- [ ] News, weather, traffic information services
- [ ] Word processor / dictation
- [ ] Record information (e.g. meetings, conversations)
- [ ] Email
- [ ] Video
- [ ] Music
- [ ] Social Media (e.g. Facebook, Twitter)
- [ ] Gaming
- [ ] Shopping
- [ ] Watch TV
- [ ] GPS navigation
- [ ] Other

If you selected Other, please specify _____

9. From **Question 7**, which item do you use the most? (Please tick **ONE** only)

- [ ] Personal desktop computer (Desktop PC)
- [ ] Laptop
- [ ] IOS tablet (iPad)
- [ ] Window tablet (e.g. Microsoft Surface, Lenovo, Toshiba Encore, etc)
- [ ] Android tablet (e.g. Samsung Galaxy Tab, Hudl, Lenovo, etc)
- [ ] Kindle tablet (e.g Kindle Fire)
- [ ] Smart phone (e.g. iPhone, Samsung, Nokia, Microsoft Lumia, HTC, Sony, Blackberry, etc)
- [ ] Normal mobile phone
- [ ] None

10. How often do you use this item in your daily activities?

- [ ] Daily
- [ ] 4-6 times a week
- [ ] 2-3 times a week
- [ ] Once a week
- [ ] Less than once a week
- [ ] Never used

SECTION 3: GAMEPLAY PATTERNS

11. Have you ever play digital games (any game on console, handheld device, smartphone, or computer including online/browser games)?

- [ ] Yes
- [ ] No

11a. From **Question 11**, what would encourage you to play any digital games? **Required*

_____

Note: If you answered '**YES' to Question 11,** please answer the following questions.
If **'NO',** please proceed to **Question 31**

11b. Why do you play digital games?

_____

12. What are the benefits of playing digital games? (Please tick **ALL** that apply)

- [ ] Social Interaction
- [ ] Fun
- [ ] Amusement
- [ ] Leisure
- [ ] Mind stimulating
- [ ] Physical exercise
- [ ] Cognition (interactive leaning)
- [ ] Overcome boredom
- [ ] Other

12a. If you selected Other, please specify

_____

12b. Please give details of your answer to **Question 12**?

_____

13. How long have you played digital games?

- [ ] Less than 1 year
- [ ] 1 - 4 years
- [ ] 5 - 10+ years

14. How often do you play digital games?

- [ ] Every day
- [ ] Several times a week
- [ ] Once a week
- [ ] A couple times a month
- [ ] Less than once a month
- [ ] I do not currently play any type of computer or digital games

15. Hours per day on average when played (past month)

- [ ] 1 hour or less
- [ ] 2 - 4 hours
- [ ] 5 – 7 hours
- [ ] 8+ hours

16. What is your skill level in playing digital games?

- [ ] Beginner (Low level)
- [ ] Intermediate (Middle level)
- [ ] Expert (High level)

16a. Please details of your answer above.

_____

17. Where do you commonly play the digital games? (Please tick **ALL** that apply)

- [ ] Home
- [ ] Café
- [ ] Care centre
- [ ] Community centre
- [ ] Learning centre
- [ ] Friend's house
- [ ] Outdoor
- [ ] Other

If you selected Other, please specify _____

18. When playing digital games, who do you play with?

- [ ] Always play on my own
- [ ] Play on my own most of the time
- [ ] Sometimes on my own/sometimes with other players
- [ ] Play with other players most of the time
- [ ] Always play with other players

18a. Please give details of your answer above. _____

19. When playing with others, who are the others?

- [ ] Family/relatives
- [ ] Friends (physically met)
- [ ] Friends (virtually met)
- [ ] Online strangers
- [ ] Not applicable

20. Which device or platform do you prefer most when playing digital games?

- [ ] Personal desktop computer (Desktop PC)
- [ ] Laptop
- [ ] Console (i.e. Xbox One, PS4)
- [ ] Wii
- [ ] Tablet
- [ ] Smart phone
- [ ] Other

20a. If you selected Other, please specify _____

20b. Why do you choose this platform?

- [ ] Cheaper
- [ ] Portability
- [ ] Lightweight
- [ ] Easy to perform tasks
- [ ] Long lasting battery
- [ ] Other

If you selected Other, please specify _____

21. Answer **ALL** that apply. Describe what are the problem(s) that you may face when you are playing digital games on:

21a. Personal desktop computer (Desktop PC):

_____
_____

21b. Laptop:

_____
_____

21c. Console (i.e. Xbox One, PS4):

_____
_____

21d. Tablet:

_____
_____

21e. Smart phone:

_____
_____

22. Based on **Question 21**, what problem bothered you the most?

_____

23. What additional feature(s) would make it easier for you to use the device of your choice when playing digital games?

_____

24. When buying a platform (electronic device such as laptop, console, tablet), do you think cost is important?

☐ Yes
☐ No

24a. If cost was not an issue, which platform would you use for playing digital games? Give the reason why.

_____
_____

25. Which game do you enjoy the most? (Please tick **ALL** that apply)

☐Puzzle ☐ Sport ☐Jigsaw

☐Action ☐ Strategy ☐ Simulation

☐Adventure ☐ Brain games ☐ Role-playing games (RPG)

☐First Person Shooter games ☐ Other

If you selected Other, please specify _____

26. Why do you choose these types of games?

_____

_____

27. What features would you like to see in a game? (Please tick **ALL** that apply)

☐Co-operation ☐ Competition ☐Challenge

☐Strategy ☐ Socialisation ☐ Fantasy

☐Deceive ☐ Affection ☐ Cognition (learning)

☐ Engagement

☐ Turn based game (players take turns when playing, i.e Chess)

☐ Immersion (ability of a game that able to attract attention)

☐Other

27a. If you selected Other, please specify _____

27b. Based on **Question 27**, what are the most essential feature(s) of a game for **YOU**? Give the reason why.

_____

_____

28. Which feature do you enjoy the most? (Please tick **ALL** that apply)

☐Mastery	☐ Immersion	☐Winning
☐Narrative	☐ Shared Fun	☐ Competition
☐Co-operation	☐ Social Interaction	☐ Tactical Play
☐ Strategic Play	☐ Integrated Theme	☐ Attractive Components
☐ In-Game Interaction	☐ Intellectual Challenge	☐ Learning New Games

Info for **Question 29** below:

Natural User Interfaces (NUI) is a common feature of human-computer interaction to enable users to conduct certain movements or gestures to make it easier for them to interact with the technologies. The current NUI available on the market are touch screen, speech recognition and gesture recognition.

29. Some people play digital games using Natural User Interfaces (NUI). What are new features (i.e. gaze tracking allows users to guide a system through eye movements) that you would like to see available in the future to make it easier to play any digital games? Please explain.

    _____

    _____

30. What are the key motivations that will make you play digital games long term?

    _____

Call For Participants!

Seeking for Healthy and Active

Men and Women

Age 55 and above …

To take part in **One Day Event** and/or **Focus Group** at **Coventry University**

If you're interested, please contact details below:

Contact : **Suriati K Jali**

Email : **jalis@coventry.ac.uk**

Mobile : **07814729221**

OR

Leave your particulars as requested below. We will contact you soon to confirm your eligibility for the focus group.

Your personal information will be kept strictly confidential.

Name : _____

Email : _____

Contact number : _____

APPENDIX 7

Call for Participants
Approach individual, forum, group & organisation

No	Name	Medium approach	Date email send	Date email replied	Response (Y/N)	Action: Approval to disseminate		Medium disseminate
						Yes	No	
1	Age UK	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
2	The Beth Johnson Foundation	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
3	Contact the Elderly	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
4	Marmalade Trust	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
5	The Silver Line	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
6	Friends of the Elderly	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
7	50+ talk	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
8	Seniors Helping Seniors – Canterbury and Thanet	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
9	Independent Age	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
10	Elders Voice	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
11	YoungDementia UK	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
12	UK Older People's Day	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
13	Carehome.co.uk	Facebook group	20-Nov-15	-	N	☐ C	☐ C	-
14	Age UK Warwickshire	Facebook group	20-Nov-15	23-Nov-15	Y	☐ C	☑ C	-
15	Age UK Solihull	Facebook group	20-Nov-15	23-Nov-15	Y	☑ C	☐ C	Facebook group
16	Age UK Coventry	Facebook group	20-Nov-15	23-Nov-15	Y	☑ C	☐ C	Facebook group / Website http://coventryoldervoices.org/
17	Coventry Carers Centre	Facebook group	23-Nov-15	-	N	☐ C	☐ C	-
18	Age Cymru	Facebook group	20-Nov-15	23-Nov-15	Y	☑ C	☐ C	Facebook group
19	Silversurfers	Facebook group	23-Nov-15	24-Nov-15	Y	☐ C	☑ C	-
20	Age UK Bedminster	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
21	Information Now	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
22	Age UK Exeter	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
23	Age UK Birmingham	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
24	Age UK Wiltshire	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
25	Age UK Lancashire	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-

26	Age UK Notts	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
27	Age UK Sheffield	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
28	AgeUK Haverhill	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
29	Age UK Leicester Shire & Rutland	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
30	Age UK Somerset	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
31	Age UK Plymouth	Facebook group	25-Nov-15	-	N	☐ C	☐ C	-
32	Age UK Hertfordshire	Facebook group	25-Nov-15	25-Nov-15	Y	☐ C	☑ C	-
33	Age UK West Sussex	Facebook group	25-Nov-15	26-Nov-15	Y	☐ C	☑ C	-
34	Age UK Newcastle	Facebook group	25-Nov-15	26-Nov-15	Y	☐ C	☑ C	-
35	Link Age Bristol	Facebook group	27-Nov-15	-	N	☐ C	☐ C	
36	Bristol Ageing Better	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
37	Age UK Bristol	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
38	Age UK Camden	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
39	Age UK Cornwall & The Isles of Scilly	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
40	Age UK Isle of Wight	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
41	Age UK Milton Keynes	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
42	Age UK Cambridgeshire	Facebook group	27-Nov-15	30-Nov-15	Y	☐ C	☑ C	-
43	Age UK Cheshire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
44	Age UK Surrey	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
45	Age UK Sunderland	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
46	Age UK Darlington	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
47	Age UK Norfolk	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
48	Age UK Norwich	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
49	Age UK Bury	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
50	Age UK Southampton (update outcomes from my study)	Facebook group	27-Nov-15	27-Nov-15	Y	☑ C	☐ C	FB Group/ Twitter / Age UK intranet
51	Age UK Gloucestershire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
52	Age UK Gateshead	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
53	Age UK Stafford & District	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
54	Age UK Reading	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
55	Age UK Croydon	Facebook group	27-Nov-15	27-Nov-15	Y	☑ C	☐ C	Twitter
56	Age UK Devon	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-

57	Age UK Merton	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
58	Age UK Berkshire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
59	Age UK East Sussex	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
60	Age UK North West Kent	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
61	Age UK Barnet	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
62	Age UK Oxfordshire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
63	Age UK Silsden	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
64	Age UK Medway	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
65	Age UK Dacorum	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
66	Age UK Lambeth	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
67	Age UK Bedfordshire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
68	Age UK South Staffordshire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
69	Age UK Burton	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
70	Age UK Cheshire East	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
71	Age UK Leeds	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
72	Age UK Richmond	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
73	Age UK Herefordshire & Worcestershire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
74	Age UK Ashford	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
75	Age UK Doncaster	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
76	Age UK Bath & North East Somerset	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
77	Age UK Brighton & Hove	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
78	Age UK Stockport	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
79	Age UK Bexley	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
80	Age UK STW Shrewsbury Supporters Group	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
81	Age UK Hillingdon	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
82	Age UK Enfield charity older-people	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
83	Age UK Hull	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
84	Age UK Portsmouth	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
85	Age UK Oldham	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
86	Age UK Hereford & Localities	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
87	Age UK Sheppey	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-

88	Age UK Buckinghamshire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
89	Age UK Sutton	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
90	Age UK Barnsley	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
91	Age UK Mid Hampshire	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
92	Wolverhampton Over 50s Forum	Facebook group	27-Nov-15	-	N	☐ C	☐ C	-
93	Association for Education and Ageing	Fb group / Email	29-Nov-15	30-Nov-15	Y	☐ C	☐ C	-
94	Coffee Pot Computing	Facebook group	30-Nov-15	-	Y	☐ C	☐ C	-
95	The International Federation on Ageing	Facebook group	7-Dec-15	-	N	☐ C	☐ C	-
96	East Sussex Seniors Association	Facebook group	7-Dec-15	-	N	☐ C	☐ C	-
97	Age Scotland	Facebook group	11-Dec-15	-	N	☐ C	☐ C	
98	Buzz50	Website www.buzz50.com	24-Nov-15	24-Nov-15	Y	☑ C	☐ C	FB Group
99	The Quality of Life Partnership/Elders Council of Newcastle	Email	25-Nov-15	25-Nov-15	Y	☑ C	☐ C	Weekly bulletin
100	Gerontoludic Society	Email	23-Nov-15	-	Y	☑ C	☐ C	Email
101	Older People Forum	Email	24-Nov-15	-	N	☐ C	☐ C	-
102	Cambridge COPE	Email	24-Nov-15	-	N	☐ C	☐ C	-
103	Eastbourne Seniors Forum	Email	24-Nov-15	-	N	☐ C	☐ C	-
104	Eato Sue (C&W Partnership Trust)	Email	24-Nov-15	-	N	☐ C	☐ C	-
105	Kamaljit Kaur (Age Friendly City Initiative	Email	23-Nov-15	24-Nov-15	Y	☑ C	☐ C	Age UK Coventry website
106	Link Age West of England	Email	30-Nov-15	30-Nov-15	Y	☑ C	☐ C	Committees & members
107	Bristol Older People's Forum CIO	Email	30-Nov-15	-	N	☐ C	☐ C	-
108	Warwickshire County Council	Email	30-Nov-15	16-Dec-15	Y	☐ C	☑ C	-
109	Birmingham City Council	Email	30-Nov-15	3-Dec-15	N	☐ C	☑ C	-
110	Staffordshire County Council	Email	30-Nov-15	-	Y	☐ C	☐ C	-
111	Manchester City Council	Email	30-Nov-15	-	N	☐ C	☐ C	-
112	Leeds Older People's Forum	Email	30-Nov-15	-	N	☐ C	☐ C	-
113	Frank Walsh House	Email	3-Dec-15	-	N	☐ C	☐ C	-
114	Hastings Older Peoples Ethnic Group (HOPE G)	Email	7-Dec-15	-	N	☐ C	☐ C	-
115	University of the Third Age (U3A)	Email	7-Dec-15	8-Dec-15	Y	☐ C	☑ C	-
116	Wandsworth Older People's Forum	Email	30-Nov-15	8-Dec-15	Y	☑ C	☐ C	Website

117	The Older People Wales	Email	14-Dec-15	15-Dec-15	Y	☑ C	☐ C	Twitter
118	Centre for Ageing Better	Email	14-Dec-15	15-Dec-15	Y	☐ C	☑ C	-
119	Security Office, UoB	Email	21-Dec-15	-	N	☐ C	☐ C	-
120	Science Postgraduate, UoB	Email	21-Dec-15	-	N	☐ C	☐ C	-
121	The older gamers (TOG)	Forum	21-Dec-15	2312/2015	Y	☑ C	☐ C	Website www.theoldergamers.com

Call for Participants
Approached individual

No	Name	Medium approach	Date email send	Date email replied	Response (Y/N)	Action: Approval to disseminate		Medium disseminate
						Yes	No	
1	Ind 1	F2F, Email	7-Dec-15	7-Dec-15	Y	☐ C	☐ C	Email / Phone
2	Ind 2	Email	21-Nov-15	23-Nov-15	Y	☐ C	☐ C	Email
3	Ind 3	Phone	3-Dec-15	3-Dec-15	Y	☑ C	☐ C	Phone (SMS/WHATSAPP)
4	Ind 4	FB / Email	11-Nov-15	11-Nov-15	Y	☑ C	☐ C	Email / FB (MBA)
5	Ind 5	Email	20-Nov-15	20-Nov-15	Y	☑ C	☐ C	Email to friend in Belfast
6	Ind 6	Email	20-Nov-15	20-Nov-15	Y	☑ C	☐ C	Email / Oral
7	Ind 7	Email	20-Nov-15	-	N	☐ C	☐ C	-
8	Ind 8	Email	20-Nov-15	20-Nov-15	Y	☑ C	☐ C	Email / Oral
9	Ind 9	Email	21-Nov-15	25-Nov-15	Y	☑ C	☐ C	RSVP
10	Ind 10	Email	20-Nov-15	-	N	☐ C	☐ C	-
11	Ind 11	Email	20-Nov-15	23-Nov-15	N	☐ C	☑ C	Email
12	Ind 12	Email	22-Nov-15	-	N	☐ C	☐ C	-
13	Ind 13	Email	22-Nov-15	-	N	☐ C	☐ C	-
14	Ind 14	Email	22-Nov-15	-	N	☐ C	☐ C	-
15	Ind 15	Email	22-Nov-15	-	N	☐ C	☐ C	-
16	Ind 16	Email	23-Nov-15	23-Nov-15	Y	☑ C	☐ C	Email (RVSP)
17	Ind 17	Email	23-Nov-15	23-Nov-15	Y	☑ C	☐ C	Email (E-dition)
18	Ind 18	Email	22-Nov-15	23-Nov-15	Y	☑ C	☐ C	Email / Poster form (Age UK Coventry)
19	Ind 19	Email	23-Nov-15	24-Nov-15	Y	☑ C	☐ C	Email to Age UK Coventry
20	Ind 20	Email	25-Nov-15	25-Nov-15	Y	☑ C	☐ C	Weekly bulletin
21	Ind 21	Email	23-Nov-15	23-Nov-15	Y	☑ C	☐ C	Email to Scienc School, UoB
22	Ind 22	Email	24-Nov-15	-	N	☐ C	☐ C	-
23	Ind 23	Email	23-Nov-15	30-Nov-15	Y	☑ C	☐ C	Email (RVSP)
24	Ind 24	Email	30-Nov-15	30-Nov-15	Y	☑ C	☐ C	Email (RVSP)
25	Ind 25	Email	9-Dec-15	-	N	☐ C	☐ C	-
26	Ind 26	Email	9-Dec-15	-	N	☐ C	☐ C	-

27	Ind 27	Email	20-Nov-15	4-Dec-15	Y	☑ C	☐ C	Email (friends)
28	Ind 28	Email	10-Dec-15	12-Dec-15	Y	☐ C	☐ C	-
29	Ind 29	Email	21-Dec-15	21-Dec-15	Y	☑ C	☐ C	Verbal/Email
30	Ind 30	Email	21-Dec-15	-	N	☐ C	☐ C	
31	Ind 31	Email			Y	☑ C	☐ C	Verbal/ Email/ Print Out

APPENDIX 8

Keywords retrieved from interview on both platforms (console and tablet). *Attributes can be considered*

No	Category (Keywords)	Code	No of People Making Comments (Frequency)
1	Challenge	1. Could be bigger (screen) - *P1F1,* 2. *'The purple is distracting from the words/instruction that I need to read. The introduction on the screen is clear but I could not read it due to font and colour (This is for the bowling game)' - P2F1,* 3. Clear picture. Colours need to be toned down a bit - *P2F2,* 4. *On skiing, background sound is irritating but you need the commentary - P3F2,* 5. Screen size OK but can't see brake or accelerator (car racing game) - P2F*3,* 6. *TEXT could be improved and a little longer (show) on screen - P2F4,* 7. Graphics could be improved to be more life like actually they could be a lot better - P2F4, 8. *Graphics not good enough - P2F4* 9. I just like the best graphics possible – P2F4 10. *Anything that I said about that one. That particular tablet. That's quite heavy. .. Try to manipulate it on your wrist. It's quite a heavy tablet isn't it? Again, if you talk in older people who may well find their wrists are not that strong, it might be awkward to manipulate. Because it's quite heavy.- P1F3* 11. Yeah, it's heavy. yeah. – P3F3 12. *Some problems with ski game as jumping did not work well with my knees although I am quite active and do leap about with Morris dancing, but movement for game was different and difficult for me.With tablet bowling I felt that the control of delivery did not work well for me – sliding fingers along screen did not seem to work very well – could not find way to line up the intended path. - P1F4* 13. Displays seemd good to me, despite my having less than perfect vision. Touch screens might present difficulties at times, as reaction to contact is not always what one expects. – *P1F4* 14. *I'm quite happy to play if somebody is got 'em there. You know, set them up, we want to play. – P1F3* 15. For me, I think one of you contagious are having a game like on the tablet. It's a fact that you may want a facility like increase a size of.. you know... it likes when you really on kindle... u	15

		know... if you got the ability to increase the size font if you find it awkward to read... u know... and you could increase the size of things as zoom in and out or you can alter the contrast. If it something that's got sound, you can increase the volume. For me, I think there is a place for those sort of things. And I can see ... more in some places (?). I think, for me the issues always about how reliable the technology is and in terms of battery life to remember - P1F3	
2	Ergonomic	1. Some are excellent the graphics are great on IOS 8 - P2F4 2. *I just like the best graphics possible – P2F4* 3. Anything that I said about that one. That particular tablet. That's quite heavy. .. Try to manipulate it on your wrist. It's quite a heavy tablet isn't it? Again, if you talk in older people who may well find their wrists are not that strong, it might be awkward to manipulate. Because it's quite heavy.- P1F3 4. *Yeah, it's heavy. yeah. – P3F3* 5. Tablet driving showed promise – I liked the use of tablets motion sensing for steering. – P1F4 6. *U want to know it always there and pause (remind??) it. And, if you accidentally press the... give me all the picture... buttons, nothing on the screen - no icon... u got to know how to get back and that is not always obvious. And the game is essential. Got to be auto reset (undo) what you just done. – P4F3* 7. I was pleasantly surprised by some features on the tablet (mainly the steering by tilting it – I hadn't thought of that as an option before the session), and the details visible were better than I would have thought beforehand. - *P1F4*	7
3	Social Interaction	1. Verity mentioned that she had played console game before at her brother house on Xmas day. Think it very funny to play with her family - playing tennis and hv a situation that is funny... ask other person to move a little bit. – P1F3 2. *But I prefer to... but I don't mind playing with people like here (*means the focus group session*)... physically in the room. Even though both relatively stranger. Because of physically together in that... it's fine. Because I can see them and we got the interaction. - P1F3* 3. It's fine. I enjoying penguin and cafe. – P4F3 (*playing game with his grandson) 4. *I supposed... I do like social interaction. But I don't use to have anybody else to play with. Now u see...*chuckle* - P2F4* 5. I'm more used to playing computer games as single user. I would think initially would be uneasy about not being able to start and finish as I wanted. Also the problem of matching performance. If one of us is performing significantly better or worse than the other(s), I would feel ill at ease I think. - *P1F4*	5

4	Rules	1. Sometimes before playing the game, it wasn't always clear what we were meant to be looking at - P1F3, 2. *Raising hand to get the 'hand' is annoying as it didn't respond to me in real time - P2F3,* 3. I think it's absolutely crucial the right from the beginning you have the instructions that explaining exactly what you're doing and why? And you know, if you do something... this is what would happen... cause otherwise, you think... yeah, just lost! – P1F3 4. *Instruction (written or narrative) - I think in this be viable both ways because actually when you looking at screen, something in your ear telling what to do is good, for me. But then, I got quite good hearing. There are people don't hear very well. So they got to have it and on the screen. So it got to be both ways. But I think, having a clear screen and something in your ear would be very useful. - P4F3*	4
5	Sensory Stimuli	1. Needs more accuracy for touch screen - P2F2, 2. *In 'driving' game, the response to button control didn't seem very good - Difficult to judge effect. - P1F4* 3. Identifying controls may have taken a bit of time, but that would be expected for a first time with a particular item of equipment. – *P1F4*	3
6	Engagement	1. They are for engagement, but they can be time wastes - P1F3 2. *They were generally stimulating and relaxing at the same time. I would enjoy playing the games again (Perhaps not the tablet bowling in it's current form) . The fun is the first component of the attraction , but then the idea of seeing ways to improve performance, or just check out different ways of playing the games. – P1F4* 3. I enjoyed them some more than others. I would enjoy playing the games again. To have fun and relaxation or to learn something a challenge - P2F4	3
7	Competition	1. With more than one person I like competition. … Good, I always want to win. *chuckles* - P2F4	1
8	Co-operation		

APPENDIX 9

List of Components in Different Game-based Learning Frameworks and Model

MDA Framework	RETAIN Model	4DF	ADGL Framework
Mechanics describes the particular components of the game, at the level of data representation and algorithms. **Dynamics** describes the run-time behaviour of the mechanics acting on player inputs and each other's outputs over time. **Aesthetics** describes the desirable emotional responses evoked in the player, when he/she interacts with the game system.	**Relevance** – Presenting materials in a way relevant to learners, their needs, their learning styles. Ensuring the instructional units are relevant to one another so that the elements link together and build upon previous work **Embedding** - Assessing how closely the academic content is coupled with the fantasy/story content where fantasy to the narrative structure, storylines, player 's experience, dramatic structure, fictive elements, etc **Transfer** – The player can use previous knowledge and apply it in other areas **Adaptation** – A change in behaviour as a consequence of transfer **Immersion** – Players intellectually investing in the context of the game **Naturalisation** – The development of habitual and spontaneous use of information derived from the game	**Context –** The place learning taking place, the disciplinary and additional resources used **Learner specification** – Study about the learner and their needs. It is important to make sure there is interaction between the learner and their environment **Internal Representational World** – The mode of representation, the interactivity, the levels of immersion and fidelity used in the game or simulation **Pedagogic perspective** – Consideration of different types of learning and teaching models embedded and personalised with the methods to support the learning processes.	**A) Learner**: **Psychological needs –** Need to adapt gaming behaviour based on the profile of the player **Cognitive development** – Suitable type of game to enhance learning process **Learning behaviour** – Identifying learner's need **B) Game Design:** **Multimodal** – describes two elements; i) *Modality* – manages the interaction between the learner and the game. Consists of the multimedia elements (i.e. text, images, sound), interface design (i.e. simple but highly meaningful to make sure the learner easily adapt to the game environment) and narrative (focus on game flow i.e. good storyline to engage the learners and bring enjoyment to them) ii) *Interaction* – helps to keep learners' attention (in control of the game) and motivates them in continuing the game (learn from the game). **Task** – In game, learner learns the learning content via the tasks given. These tasks are designed with different levels of difficulties in order to help learners adapt to the game environment without being discouraged. **Feedback** – describes that in evaluating learner assessment the direct or indirect clues; and results should be given on demand to reduce learner's misunderstanding and make sure the learner receives the right information. By proving rewards will also encourage the learner to play longer and continue to play.

APPENDIX 10

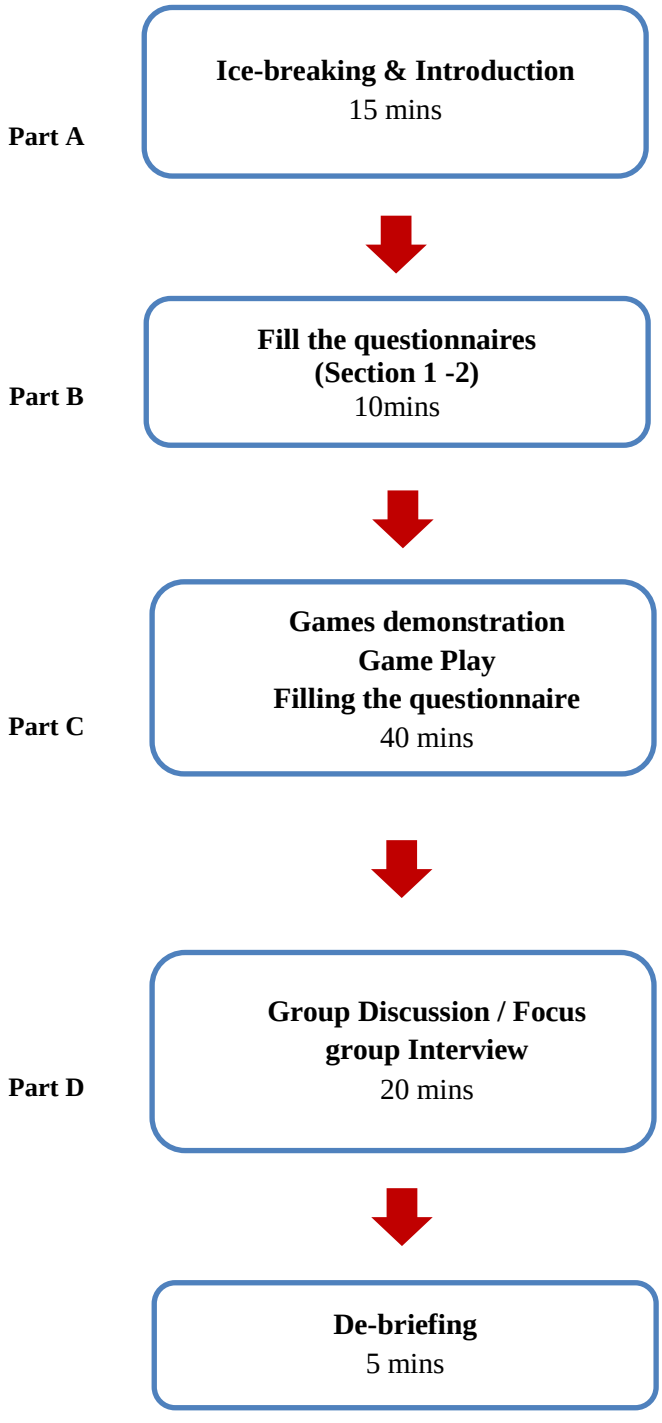
Game Attributes and Definitions (adapted from Wilson *et al.* (2009))

Attribute	Definition	Source
Adaptation	The level of difficulty adjusts to the skill level of the player by matching challenges and possible solutions.	Prensky, 2001
Assessment	The measurement of achievement within the game (e.g., scoring). Tutorials teach players how to play the game and what aspects are important to achieving the goals. Scoring compares performance among players. Feedback provides a tool for players to learn from previous actions and adjust accordingly.	Chen & Michael, 2005
Challenge	The ideal amount of difficulty and improbability of obtaining goals. A challenging game possesses multiple clearly specified goals, progressive difficulty, and informational ambiguity.	Garris, Ahlers, & Driskell, 2002; Owen, 2004
Conflict	The presentation of solvable problems within the game and usually drives the game's plot or in-game action by providing interaction. Four types of conflict exist: (a) direct, (b) indirect, (c) violent, and (d) nonviolent.	Crawford, 1984
Control	The player's capacity for power or influence over elements of the game. Learner control occurs when the learner has control over some aspects of the game. Instructional program control determines all elements of the game.	Garris et al., 2002
Fantasy	Make-believe environment, scenarios, or characters. It involves the player in mental imagery and imagination for unusual locations, social situations, and analogies for real-world processes. Exogenous fantasy is a direct overlay on learning content and dependent on the skill, but the skill does not depend on the fantasy. Endogenous fantasy is related to learning content and essential relationship between the learned skill and the fantasy context (engaging and educational).	Garris et al., 2002; Owen, 2004; Habgood, Ainsworth, & Benford, 2005
Interaction (equipment)	The adaptability and manipulability of a game. The game changes in response to player's actions.	Prensky, 2001
Interaction (interpersonal)	Face-to-face interaction, relationships between players in real space and time. It provides an opportunity for achievements to be acknowledged by others and challenges become meaningful, which induces involvement.	Crawford, 1984
Interaction (social)	An interpersonal activity that is mediated by technology, which encourages entertaining communal gatherings by producing a sense of belonging.	Prensky, 2001
Language/ communication	Specific communication rules of the game, and may be a significant part of the game. The two types of communication are verbal and text.	Owen, 2004
Location	The physical or virtual world that the game takes place. It influences rules, expectations, and solution parameters. The location may be real or fantasy and space may be bound, unbound, or augmented.	Owen, 2004

Mystery	The gap between existing information and unknown information. It is a product of discrepancies or inconsistencies in knowledge. This attribute is enhanced by information incongruity, complexity, novelty, surprise and expectation violation, idea incompatibility, inability to make predictions, and incomplete or inconsistent information. Sensory curiosity is the interest evoked by novel sensations, and cognitive curiosity is the desire for knowledge related with curiosity (inverse quadratic).	Garris et al., 2002
Pieces or Players	Objects or people (e.g., proxy items, avatars, or human participants) being included in the game narrative or scenario.	Owen, 2004
Progress	How the player progresses toward the goals of the game.	Owen, 2004
Surprise	The random elements of the game.	Owen, 2004
Representation	The player's perceptions of the game's reality. It is a subjective feature that makes the game appears psychologically real. Narrowing the scope of representation provides a focus for the player.	Crawford, 1984
Rules/Goals	Rules are the goal makeup of game and establish criteria for how to win. Specific, well-defined rules and guidelines are a necessary component for an effective educational game, as well as feedback on progression toward achieving the goals. Three types of rules exist: (a) system rules (i.e., functional parameters inherent in the game), (b) procedural rules (i.e., actions in the game to regulate behaviour), and (c) imported rules (i.e., rules originating from the real world).	Blunt, 2007; Garris et al., 2002; Owen, 2004
Safety	Disassociation of actions and consequences (i.e., safe way to experience reality). The only consequence is a loss of dignity when losing. The results are less harsh than modelled scenarios.	Crawford, 1984
Sensory Stimuli	Visual or auditory stimulations, which distort perception and imply temporary acceptance of an alternate reality.	Garris et al., 2002

APPENDIX 11

FOCUS GROUP SESSION FLOW



- Review on consent form (highlight about recorded session, voluntary participatory)
- Brief Introduction to the project (topic and agenda)

- Game play using different devices/platforms
- Contextual inquiry is perform (feedback on games learning outcome, imrpovements and overall usability and game mechanism), filling the questionnaires (during gameplay)
- Filling the questionnaires (after gameplay)

- Group discussion (unstructured interview, card-game/sorting, role-play, post on the wall)

Summary of the session – researcher share perspectives and insights about what occurred during the session

- What have/have not been achieved